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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

Institute of British Foundrymen.

OCTOBER 19.

Lancashire Branch (Burnley Section):—First meeting of the session at Accrington. W. H. Poole will read a Paper on "The Cupola."

Wales and Monmouth Branch:—Ordinary meeting at Newport. "Coal-Dust," Lecture by Ben Hird.

West Riding of Yorkshire Branch:—Visit to Messrs. E. Green & Sons, Limited, of Wakefield, also Lecture on "Some Notes on the Condition and Effects of Graphite on Cast Iron," by H. R. Pitt.

OCTOBER 21.

Sheffield and District Section:—Ordinary meeting at Sheffield. "Modern Methods of Testing and Examination and their Influence on the Design of Castings," Paper by J. S. Glen Primrose.

OCTOBER 24.

London Branch:—Ordinary meeting in London. "Cupola Refractories," Paper by C. Presswood.

Whiteheart Again.

The whiteheart malleable industry was developed originally in a field where the expression of properties in terms of definite strength and ductility was not required. The growth of the engineering demand, however, has inevitably introduced the question of specifications for malleable. Moreover, even for those who do not make engineering malleable and who therefore do not have to meet such specifications, it has been found that regular testing is an admirable method of controlling the regularity of the manufacture. The B.E.S.A. specification demands a tensile strength of 20 tons with a 5 per cent. elongation. In whiteheart the former figure presents no difficulty at all, and in fact it is inclined to be on the low side. But there are very few firms that are able consistently to produce an elongation of 5 per cent. The recent German foundry exhibition showed indications that in these respects the malleable iron manufacturers of Germany are a long way ahead of those in Great Britain. A large number of results were shown. Cupola-made whiteheart malleable showed elongations of 4 to 9 per cent., accompanied by tensile strengths of 25 to 34 tons per square inch. Open-hearth whiteheart gave similar figures. The electric furnace gave an elongation up to 12 per cent., with a tensile strength of 25 to 40 tons per square inch. It is worth noting here, however, that the German specification basis is slightly different from the British, being 4 per cent. elongation and 25 tons per square inch tensile strength, but the elongation is measured on the slightly longer gauge length of 2.4 in. It was also evident from the figures available on the same occasion that whiteheart made in the pulverised fuel furnace, which may be regarded for this purpose as an ordinary air furnace, has a much higher elongation. Figures were shown indicating that this goes up to over 20 per cent., the tensile strength being of the order of 26 tons per square inch. One of the most interesting features of the section of the exhibition dealing with malleable was a chart indicating the much superior elongation of whiteheart made with a manganese content of 0.3 per cent., as compared with whiteheart made with a manganese content of 0.15 per cent. This confirmed the conclusions of the Paper that was presented to this year's London convention on the influence of manganese. The malleable manufacturers of Germany are extremely well organised, and the manufacturers' association has over one hundred members. What is more, they are taking advantage of this organisation to improve their product technically, and that their efforts are not unsuccessful is clearly demonstrated by the figures cited.

Rationalisation and Practical Reactance.

During this last week-end we took advantage of the opportunity of questioning three prominent foundrymen as to what they understood by rationalisation. Curiously enough, their reaction checked up with each person's particular niche in industry. The foundry owner immediately seized on horizontal trustification, with the object of eliminating obsolete plant and the concentration of manufacture in the most economic units available to the combine. This is exemplified by the recent proposed amalgamation of Dorman Long's and Bolckow Vaughan's, or Allied Ironfounders, Limited. The metallurgist took the view that rationalisation meant the review of existing manufacturing processes so as to put into practice the latest scientific methods and so save effort and waste. The reaction of the practical man to the question was that an effort should be made to get the best out of each shop by an intense application of logical thought—tidiness, good lighting, heating and ventilation, routing and modernisation commensurate with the finance available.

It is obvious from these answers that the practical interpretation of this word has resolved itself into "an effort being made by all in industry to apply waste-eliminating methods within his own sphere." Mr. Gardom's definition is the "conservation of human energy; elimination of all waste, and increase of daily output per man, and with it his remuneration," which is virtually the same but more indicative. Now, the definitions of the owner, the metallurgist and the practical man were more than ordinarily interesting, as they showed in no uncertain manner that the basic principles had reached the stage of the possibility of personal application. Each one had responded by a realisation of where his personal contribution should be made. Only recently we wrote that a mental revolution amongst those engaged in industry was taking place, and where it will end is still on the knees of the gods. That the Trade Unions are interested is patent, because of the Melchett-Turner "conversations." There is a realisation amongst many of the more deeply-thinking trade-union leaders, that once a management pays more than the district trade-union rate of wages, their representatives cannot "sell a membership" to the recent recruits to industry. They hope to find in a closer relationship with the management a sphere where they can help industry, with the final object in mind of the betterment of the social conditions of the employees generally. The mere gaining of a high wages level is often of but temporary duration, whereas the placing of any section of an industry on its highest economic plane—rationalising—ensures at least the possibility of attaining the true maximum labour-reward, and with a reasonable assurance of continuity.

XUM

Correspondence.

Rotating Melting Furnaces.

To the Editor of The Foundry Trade Journal.

Sir,—Owing to my absence from England during the greater part of last month, I have only just had the opportunity of reading through the September 12 and 19 issues of your Journal. I find in both issues a large amount of space is devoted to what is described as the Brackelsberg furnace. Yet British Patent No. 283,387 (German Convention date, March 9, 1927), "Improvements in Processes and Apparatus for Heating Smelting Furnaces," granted to Carl Brackelsberg, refers to a method of firing powdered fuel into a rotating furnace of known type in a special way. The time has now arrived when the British foundry public should realise that the Büess furnace, British Patent No. 274,451 (Improvement in or relating to Rotary Melting Furnaces, German Convention date, July 16, 1926), incorporates all the advantages of its younger brother with many additional features. Primarily, it can be fired by gas, oil, electricity or powdered fuel. Other claims are: (1) Speedier melting and reduced fuel costs owing to the better mixing of the charge; (2) speedier and more perfect reaction and refining owing to the continuous movement given to the molten metal; (3) means of automatically charging alloys in predetermined quantity whilst the furnace is at work; and (4) means of charging small scrap or turnings automatically during the melting period.

In your leading article, "A Rival to the Cupola" (August 8), you announced that the British patent rights of a furnace had been purchased by a very large foundry concern. This will now be identified as the Büess furnace, and a five-ton unit is now in course of manufacture and will be in commission in two months' time.

All test results so far obtained in Germany show in no uncertain manner that this novel and practical furnace already offers very considerable advantages to malleable and high quality iron-founders.

Your description of the models of the Büess furnace as shown at the Düsseldorf Exhibition gave an erroneous impression that the whole furnace turns on eccentrically disposed journals, whereas the body only is actuated eccentrically, and that this action is performed without any disturbance to the slag covering.

The fullest information relating to the Büess furnace will be forthcoming in the near future and will be placed before the public through the medium of your columns.—Yours, etc.,

John A. Smeeton.

15, Victoria Street, London, S.W.1.

The New Foundry of Messrs. Morris Motors, Limited.

To the Editor of The Foundry Trade Journal.

Sir,—Your issues of September 26 and October 3 are, in my opinion, two of the best put before the foundry trade, and I would like to suggest, in support of the policy of Messrs. Morris Motors, Limited, "Buy British Cars," that extra copies of The Foundry Trade Journal, if at all possible, should be sent to the various libraries attached to the British Consular Offices in different parts of the world.

Through the medium of your valuable journal you have followed the policy of "Buy British Goods" by following up "Utilises Solely British Equipment," and one cannot speak too highly of the way in which you have handled the articles and in illustrating the very fine photographs of the new foundry of Messrs. Morris Motors, Limited. The two articles make very pleasing reading, and in conclusion I think Messrs. Morris Motors, Limited, coupled with the name of Mr. A. Smith, should be congratulated, and also to you, Sir, as the Editor of the articles, and finally the issues in question are the finest advertisement that the Foundry Trades and Equipment Supplies of Great Britain have had for a considerable time.—Yours, etc.,

For Beecroft & Partners, Limited.
G. C. Castle,
Managing Director.

Retort Works, Mappin Street, Sheffield.
October 8, 1929.

The Grangemouth Cupola Plant.

To the Editor of The Foundry Trade Journal.

Sir,—In your issue of July 25 a paragraph was published giving details of the starting up of a new cupola at our works, and, incidentally (very justly) mentioning the fact that to Mr. J. E. Fletcher, Consultant, British Cast Iron Research Association, was due some share of the credit in designing the cupola. This statement has apparently caused some misunderstanding in the minds of ironfounders, and in all fairness to the Association, and Mr. Fletcher in particular, we feel it encumbant to give the facts, which are as follows.

The cupola was purchased second-hand at a sale in the west of Scotland some years ago. The undersigned had original views with regard to the design and lay-out of a cupola house, and when the firm was in a position to commence its erection, the cupola was introduced into this scheme, and the whole erected in the early part of this year.

We consulted the Association with regard to modifications in the design of the cupola to give the best results, and it was here that Mr. Fletcher stepped in to assist the firm, and although the Association gave the firm no further services, we feel that our membership for this alone has been justified. The alterations to the cupola were carried through at our expense, by Mr. J. Walker Gillespie, cupola builder, Grangemouth, to drawings supplied by ourselves. Consultations are still proceeding with the B.C.I.R.A., and we hope that the results will also be beneficial to the Association and its members.

Mr. Fletcher was in no way a party to the contracting or the actual building of the cupola, and we trust that you will see your way to publish the above to prevent misunderstanding.—Yours, etc.,

For Grangemouth Iron Company,
Jas. M. Primrose, General Manager.

Falkirk.
October 14.

Sheffield Metallurgists at National Metal Congress.

One of the features of the National Metal Congress and Exposition, held in Cleveland, U.S.A., last month, was the presence of a large number of men who were either born or educated in Sheffield. Many of them have made notable contributions to the science and advance of steel metallurgy in different lines, and amongst them were the following:—

Dr. George B. Waterhouse, now Professor of Metallurgy, Massachusetts Institute of Technology; Charles K. Everitt, managing director, Edgar Allen & Company, Sheffield; Sidney Grayson, president, Jessop Steel Company, Washington; Frank Hodson, president, Empire Steel Castings, Incorporated, Reading, Pa.; J. Kent Smith, consulting metallurgist, and associated with Climax Molybdenum Company, Detroit; Allwyn Wild, president, Rustless Iron Corporation of America, Baltimore; Victor F. J. Tlach, president, Darwin & Milner, Incorporated, Cleveland; Oliver Smalley, consulting metallurgist, New York, and associated with Jessop Steel Company, Washington; F. C. A. Lantsberry, William Jessop & Sons, Sheffield; George Batty, director of the Steel Castings Development Bureau, Philadelphia; Frank W. Brooke, chief engineer, William Swindell Bros., Pittsburgh, and T. Holland Nelson, consulting metallurgist, Philadelphia.

Random Shots.

The other day I encountered something that seemed to me very typical of a country where the designers of artistic mausoleums advertise in all the best magazines and where undertakers prefer to be known as morticians. In an account of the National Metals Exposition held recently in Cleveland (U.S.A.)—while you and I were in Düsseldorf, as a matter of fact—I read of a small cast-iron tombstone, enamelled to look like granite, that was shown by the Grey Iron Institute. (Sorry, my friends across the herring-pond, but the Editor doesn't like "Gray," so I am obliged to translate!) The suggestion was, apparently, that there was a promising new opening for the fruits of our industry! What do the stone-masons say about it, I wonder? And what would the English climate say? These are mysteries to which I have no clue. But it all goes to bear out the theory that members of the same family are the readiest to disagree!

* * *

I also noticed that the American Foundrymen's Association was represented on this occasion, in spite of its primarily non-ferrous character. This question of the relations between ferrous and non-ferrous interests seems to be worth a moment's thought—but perhaps the thought should proceed from a better brain than "Marksman's." On the occasion in question, incidentally, Cleveland had to put up—and put up with—a little matter of 5,840 visitors, who devoted their attention to no more than 94 papers in the course of an entire week! We have a long way still to go along that particular road! Personally I am hoping that there may be some alternative. We do want our annual conventions to be a success, but we don't want them to develop into mere mass meetings. To speak seriously for a moment, what hope is there of personal contact or helpful discussion when a convention becomes so vast a concentration of men and ideas?

* * *

As far as our own conventions are concerned, they are still well within manageable limits. But I am glad next summer will see us in Middlesbrough. Marksman yields to no man in his liking for London—even when the Strand is up and the fountains in Trafalgar Square are dry (which they were until the drought ended officially on October 9), but it isn't the ideal place for a convention. In so large a centre there is an inevitable scattering of interests—this man has friends to visit, that man has business to attend to, you want to see the sights and I want to go to some shows. But in a provincial city the distances are so much less, the rival attractions so far fewer, that the Convention remains the centre of interest. My intention is in no way to criticise any of our highly successful London gatherings, either general or in particular, but if you think about it I fancy you will agree that the primary objects of these events are probably better served elsewhere.

* * *

To which discussion the following little story is apposite. A party of twenty moulders from the North were in London for the day, and they were very much impressed by the crowds and the general activity. Approaching a policeman outside Charing Cross, therefore, one of them said: "What's on in Lunnon to-day?" The policeman replied that there was nothing special on, that it was always like this, and that there were no more people in London than usual. "Ee, lad, tha's wrong," said the country cousin, "there's twenty o' us from Burnley, for a start!"

Marksman.

Tyneside Foundry Conditions.

MR. SMITH'S PRESIDENTIAL ADDRESS.

The first meeting of the session was held on September 28, in the Neville Hall, Newcastle-upon-Tyne, when Mr. R. H. Smith delivered his presidential address, in the course of which he said:—"Gentlemen,—When I think of the number of eminent men who have previously held the honoured position of President of the Newcastle Branch of the Institute of British Foundrymen, I am proud to feel that you have seen fit to elect me to fill it for the next twelve months. The past record of this Branch of the Institute of British Foundrymen is a wonderful one, and I realise that such prestige *must* be maintained. The subject which is uppermost in my mind just now is the welfare of this Institute—what it has done in the past, what it can do in the future, and the duty that every one of us owes to it as loyal members.

The I.B.F. has been a tower of strength to us all, in more ways than one, during the post-war days of difficulty and depression. They have been years of great anxiety as far as industry is concerned, in which foreign competition and disputes arising in many cases from jagged nerves have played a great part. Firms throughout the length and breadth of the country have held on doggedly, hoping and feeling that some day things would improve. Through such a time as this it cannot be denied that the I.B.F. has helped us all. We have met at regular intervals, have heard Papers overflowing with wisdom and useful information. Discussion has been open and freely conducted, and I say quite emphatically that there is not an individual present who has not profited in some way from his association with others in the same trade. We must all have received mutual help at some time or other—perhaps we have been shown a partial way through difficulties, of which we all must have our share.

A few years ago the best and ablest founders of the age ridiculed the idea of co-operation between such a theoretical being as a chemist, and such a matter-of-fact practical man as a founder. During the last few years, however, we have seen a definite lessening of that opposition. The founder agrees to-day that in many ways the chemist can, and does, help to produce sounder and better castings, and now I believe that co-operation is an established fact. I do feel that we are moving forward—and who dares to say that the Institute of British Foundrymen has had no hand in such a movement? Who can say to what heights of improvement and efficiency such co-operation, strengthened and cemented through institutes like ours, will lead us? We have tended to combine in harmony the theoretical and the practical. Neither can reach perfection apart. Together they can make almost anything possible.

This co-operation is not limited to chemists and founders. There is room for it between engineers and founders, between patternmakers and founders, draughtsmen and founders—indeed, between any and every branch of engineering, and it is coming—the beginning has already been made—thanks to the free interchange of opinion as expressed through the medium of institutes like our own. There may be argument—we cannot have free discussion without it—but it all leads somewhere, and my firm belief is that it will lead us to better times and greater efficiency.

The social side has not been overlooked, for nothing broadens one's mind so much as experience and travel, and that is why I contend that visits to works of all sorts and sizes broadens the mind of every individual in this Institute. It does us all good to see 'what the other feller does'—particularly if we venture further and ask why he does it. Through such visits, and the discussions held later, every one of us is brought in touch with a neighbour. We all have common interests, pursuing them in similar ways, and we can further these interests by co-operation. Such a social atmosphere is bound to create interest in the minds of the younger members of our Institute—of whom I wish there were more. Those we have are interested; so much so that competition is becoming increasingly keen for the 'John Surtees' Medal, and the awarding of it much more difficult. These are only one or two ways in which our Institute has proved useful. As for the future, what greater hope can be held than that these lines of co-operation and mutual help will be extended and intensified? A remark once made by the Prince of Wales impressed me to such an extent that I can never forget it. It is this—'Service is the rent we pay for the room we occupy on earth.'

I really think that every hope I have for this Institute is embodied in that quotation. Helping one another towards knowledge and efficiency; to smooth out one another's difficulties, if it is possible, by frank discussion and genuine advice; and to round up the younger members and apprentices who do not belong to the Institute, and help them in every possible way which occurs to us.

The foundry trade is recovering after the years of anxiety. We can help it along in many ways—by practical co-operation with one another, by preaching the doctrine of a little more effort toward the production of better castings, and by striving to get the foundry trade into its proper place of importance. It is one of the oldest trades in the world, and certainly one of the most important, besides being one of the most skilled.

I have recently returned from a visit to Germany which lasted several days, but our time was so carefully planned out that lengthy examination in individual cases was not possible. Numerous foundries and allied concerns were visited in the course of a week, and many things were new and interesting. I think they use machines rather more extensively than we do in England, but, on the whole, I was left wondering how they have been able to prove such fierce competitors of ours in the past. I had heard so much of the German foundries that I went ready to be amazed at the wonderful appliances and remarkable efficiency of the industry. I came away feeling a comfortable glow of pride and convinced in my own mind that as far as the foundry trade, at any rate, is concerned we have not a great deal to learn from Germany. I refuse to ally myself to those members of the British nation who always point to the foreigner as a pattern of 100 per cent. efficiency, believing, as strongly as I do, that British workmanship and material and brains are equal, if not superior, to those of any other nation. We have a splendid illustration of it in the North-East Coast Exhibition.

We want more members, particularly the younger ones. Could I ask everyone here, therefore, to try to interest at least one young man sufficiently in our Institute to come and see us. We will be delighted to see strange faces and it will not be our fault if a strange face remains so; we want them to feel at home when they come—so much so that they will want to come again and join the Institute.

A Vote of Thanks.

Mr. Arthur Logan, Senior Vice-President, proposed a hearty vote of thanks to Mr. Smith for his Presidential Address, which they would all agree was a very excellent one. It was evident that their President had the welfare of the Institute at heart. Mr. Molineux, Junior Vice-President, seconded the vote of thanks to Mr. Smith, which was passed with acclamation.

Industrial Film Shown.

A film, "A British Key Industry," was then shown, by the courtesy of Messrs. Alfred Herbert Limited, of Coventry, who were represented by Mr. Kendall.

The film showed the works of Messrs. Alfred Herbert, Limited, of Coventry, manufacturers of machine and small tools. The site of their works covers 37 acres, the machine shop alone covering 7 acres. In turn were shown the scientific-control department, the machine shop, the pattern shop, gear-cutting department, erecting shop, testing department, where each machine is given a thorough running test before being put into stock. In the turret-lathe department there are 200 turret lathes. There are also 68 Herbert auto-lathes installed. All operations on these latter machines are automatic except chucking, and in practice it is found that one operator can conveniently look after four machines. The Herbert No. 4 capstan lathe is well known to engineers throughout the world. The demonstration department was also seen, where all the machines are shown under actual working conditions. In the reconditioning department old machines are renovated. In the stores 35,000 sets of Coventry dies are kept in stock, as well as stocks of small tools and Norton grinding wheels. The Atritor pulveriser was also shown, this machine having helped to solve the cheap-power problem.

The workers' welfare sports ground and mess room are situated near the factory, and some idea of their size can be gained when it is stated that the mess room will seat 700 people.

At the conclusion of the film, Mr. V. Stobie asked Mr. Kendall if Messrs. Alfred Herbert, Limited, had ever made machines to use with Widia steel.

Mr. Kendall replied that Widia steel had only been on the market for a couple of years. The firm had certainly experimented with it successfully and at present were selling it. To get the best results from Widia steel it was essential to have a powerful machine. The ability of Widia to keep a cutting edge is considerably greater than that of high-speed steel, and it is particularly successful in turning cast iron where it is easily possible to run at 300 surface feet per minute. It is possible to run much faster than this, and the following tests had been carried out with Widia steel:—

Cast Iron, 200 *Brinell*.

Cutting speed. Feet per minute.	Feed. In. per rev.	Depth of cut.	H.P. available.
720	004	31/64 in.	35
600	3/32 in.	3/8 in.	20

From the foregoing it will be realised the necessity of having a sufficiently powerful machine if the maximum results are to be obtained from Widia. In addition, Widia will satisfactorily turn cobalt tool steel, hard manganese steel (12 per cent. manganese), cast steel (60 tons), stainless steel, brush carbon, porcelain, etc.

In reply to a further question from Mr. Stobie, Mr. Kendall said it was recommended to withdraw the tool from the work prior to stopping the machine, otherwise it was possible the cutting edge of the Widia tool would be damaged.

It was also pointed out that Widia could be used for roughing as well as finishing cuts, and also on interrupted cuts.

Mr. Stobie asked how the cutting tool was supported. Mr. Kendall replied that it was absolutely necessary to support the tool as near as possible to the cutting edge. Vibration had to be practically non-existent. It was also recommended to use a tool of robust section, and where possible the work should be supported by suitable steady rests, thus reducing vibration. In answer to a further question from Mr. Stobie he said, generally speaking, Widia is used dry.

Mr. Kendall pointed out the necessity of correctly grinding Widia steel was an important one. The grinding wheels should preferably be run wet with a plentiful supply of water, and the wheel must meet the cutting edge of the tool and must not run away from it. For re-grinding the tip after use in a machine we recommend 60-K. Norton Crystolon or 80-D.J. Norton Crystolon wheels. After this operation it was necessary to use a 100/T.2. Crystolon Bakelite wheel. This wheel had a burnishing action on the Widia steel and removed the very slight serrations left from the previous grinding operation. Such serrations are not visible to the naked eye, but they exist nevertheless, and they will be detrimental to the success of the tool. The cutting edge of Widia tools must be finished ground with a straight line sharp edge. Mr. Kendall's experience was that a dull or broken edge will cause the tool to chip.

Mr. Stobie then asked the form in which Widia was supplied. Mr. Kendall replied that for ordinary lathe tools the shanks are made from tough steel, whilst the Widia steel is brazed on in tipped form. Flat drills had also been tipped with Widia as well as slitting saws and tools for shaping and planing machines. Widia steel could be supplied in tipped form for almost any type of tool.

Mr. Molineux said that it gave him very great pleasure to move a vote of thanks to Mr. Kendall and to Messrs. Alfred Herbert, Limited. The film had proved especially interesting to those among them who had seen many of the machines in use. It was really amazing to him to see the almost human accuracy with which some of the machines dealt with castings. Mr. Allan seconded this vote of thanks, which was passed unanimously.

Mr. Kendall, in reply to the vote of thanks, said that he would like to thank them on behalf of his company for their kindness in coming there and the facilities they had given them for showing the film. He further extended an invitation to the members to visit Messrs. Alfred Herbert's works at Coventry.

Imported Implements and Tools.

Marking Order Recommended.

The Standing Committee appointed by the Board of Trade have reported on their inquiry as to whether imported hand implements and tools should be required to bear an indication of origin. An application for a marking Order was made by the Edge Tool Manufacturers' Association, the File Manufacturers' Association, the Saw Manufacturers' Association, the British Hacksaw Makers' Association, and a number of individual firms.

The Committee recommends that the following classes and descriptions of imported goods shall bear an indication of origin at the time of sale or exposure for sale:—(*a*) Hand tools, the operative part of which is made of metal (whether or not tipped with diamond or other hard substance), of all descriptions ordinarily used by workpeople in the course of their trade or employment, including agricultural and horticultural hand tools; (*b*) saws, twist drills and bits for fitting into machines; (*c*) metal vices and cramps; (*d*) marking gauges of metal, squares and bevels, metal vernier gauges, thickness gauges or feeders, engineers' rules of metal, and steel measuring tapes; (*e*) tuning forks; (*f*) permanent magnets; and (*g*) letter and number marks. It is suggested that the indication of origin shall be applied to each article by die-stamping or other mode of impressing, etching, engraving, or casting. Exceptions are made in the case of goods which are already subject to marking Orders, toys, and tools below ¼ in. in diameter.

The President (Mr. Wesley Lambert) and council of the Institute of British Foundrymen were last Saturday the guests of the Lord Mayor and Civic authorities of Newcastle-upon-Tyne at an informal reception held in the County Hotel. Afterwards they visited the North-East Coast Exhibition.

Coal Dust and Chaos.

By Ecossais.

The opinion expressed at the 1929 convention by some members that coal dust can be dispensed with may be founded on fact, but, generally speaking, if a reasonably good skin is required on castings cast in green-sand moulds, coal dust must be used. Certainly, in the absence of coal dust due to various causes, milled sand containing sawdust, or even an excess of manure, is often used with passable results, but both of these materials are capable of acting to a limited extent in a similar capacity to coal dust owing to their organic nature.

With very light castings, a tough milled sand can be made to give a smooth face without coal dust, but generally near the runner the castings are liable to show small scabs. Also, at this same point, the sand may be burnt on, due to the fusion of the sand grains, though if this be scraped off the face may be quite smooth. It is interesting to note that in the same foundry moulders using the same proportion of coal dust get varied results, from a very fine skin without *pits* or minute *projections* to a variety of defective skins, some pitted and others covered with the minute projections referred to. The *pits* may be due to patches of coal dust, easily obtained if the coal dust is stored in a damp place, to damp particles of sand or to small pebbles or grit. The two former are due, of course, to imperfect mixing, the latter to the accidental inclusion in the new sand of some of the strata occurring in most sand pits and consisting of small pebbles, this strata being, of course, totally unsuitable for light castings where the skin must be good.

The minute projections referred to are another matter, and are due totally to bad packing or ramming, which again may be due to the moisture in the sand being excessive. Ask most moulders what percentage of moisture they use in their sand and they cannot tell you. Moreover, 7 per cent. may be suitable in one sand when hand-rammed, and in another sand 4 per cent. would be sufficient, this depending, of course, on the amount of natural bond. The sand which was apparently suitable with 7 per cent. when hand-rammed, may, on a jolt rammer, give a good skin on horizontal faces, but a rough skin on the vertical or nearly-vertical sides.

It is a mistake to think that by adding extra coal dust such roughness can be overcome. A bright casting may result and even a misrun, but a bright casting is not necessarily a smooth one.

As distinct from the use of facing sand with too high a percentage of moisture, there are occasions when the judicious application of the swab to parts of the mould adjacent to the runner may be an advantage. This is effective where, owing to the type of casting, the ingoing metal is flowing over the face of the mould for relatively a long period without actually covering it. The action of the water appears to be to create a vapour which protects the sand face against erosion and burning on until the wash of the metal is completed. Excess, of course, would mean disaster, and where this is done and a smooth skin is desired it is customary to rub the face of the mould with plumbago, the water then serving to create a damp surface only instead of saturating the mould for a good depth. With heavy-section castings and weighing about 11 cwts., the writer has made it common practice to dry, say, top and middle part, leaving the bottom part green, but polished with dry plumbago, afterwards washing the whole of the face of the bottom part with a mixture of just water and mineral blacking, this method giving a good clean skin free from scabs or burnt patches, the runners flowing directly over the bottom part. With lighter castings, as boxes up to, say, 3 ft. by 2 ft. by 10 in. by ¼ in. metal, the down gates dropping on the face of the green core, the practice was as follows. Dry blacking was rubbed on the corners on the face where the metal dropped, these parts being washed with a swab or fine brush.

On light repetition castings calling for a good skin, the best method of procedure would appear to be to provide sand-mixing machinery, in which new sand, coal dust, and floor sand are automatically controlled. The control of the moisture is a little more difficult, as the old and new sands will already contain a certain amount of moisture, and dependence must again be placed on the machine attendant.

To eliminate variations from this source would require that all materials should be dry, and even ignoring the extra expenses this would entail, mixing would be prolonged and the output of sand reduced. Variation would then be limited to those caused by weather conditions, and the length of time elapsing between mixing and using of the sand, and granted that the natural bond of the new sand remained the same the percentage of water added could remain constant.

Incidentally, a smooth casting does not necessarily mean a good casting, as it may be created by *excess* coal dust or low pouring temperature, and the writer would prefer for such a casting to machine up well; the rougher casting indicating that the metal has been sufficiently hot to expel gases through excess coal dust or moisture, which would be doubtful with duller metal

Judging from the various opinions held on the matter, it would appear that Mr. Smith's Paper, given about 20 years ago at the Sheffield Convention on Science and Rule of Thumb, still covers the ground, and that the foundryman has still to rely largely on his own observations and past experience, varying his sand manipulation according to materials available and the type of work on hand.

Book Review.

Pitman's Technical Dictionary of Engineering and Industrial Science in Seven Languages. Compiled by Ernest Slater, M.I.E.E., M.I.Mech.E. Published in 4 volumes by Sir Isaac Pitman & Sons, Limited, Parker Street, Kingsway, London, W.C.2. Price £8 8s.

The seven languages mentioned in the subtitle are English, French, German, Italian, Spanish, Portuguese and Russian.

The reviewer confesses to specialisation only in the knowledge of French metallurgical and foundry terms, and a nodding acquaintance with German, Italian and Spanish. For testing for foundry use we selected the following terms:—Moulding box, jolting machine, foundry blackings, stripping of castings, mottled iron, shanks, cope, chemical estimation, fettling, feeding head, chaplet, core iron and sand blast. Generally speaking, suitable words were forthcoming, sufficiently so to convince us that those who have to translate English technical material into foreign languages will derive considerable help. Its maximum utility will be, according to our experience of international business, in the offices of foreign concerns for translating documents received from English-speaking countries. It should be realised that the dictionary is not designed to help one to decipher a technical Paper received from abroad. We hope that some day the publishers will tackle the question from this particular angle.

The Annual General Meeting of the British Cast Iron Research Association is to be held on Wednesday, November 6, at the Hotel Cecil, London, at 12.15. It will be followed by a luncheon, over which Major-General Sir Philip A. M. Nash, K.C.M.G., C.B., will preside.

Conference on Steel Castings.

[*After the Symposium on Steel Castings,* held in Glasgow last winter, a joint Committee was appointed to summarise the findings with a view to forming a basis for further discussions. This summary is detailed below, followed by Dr. M'Cance's reply to the discussion, which was held over on account of the doctor's illness.*]

This conference extended over a series of evenings during the winter of 1928-29, and was brought together by the joint action of the Glasgow branches of the Institution of Mechanical Engineers and the Institute of British Foundrymen. The scope of the conference was extended to include the interests of the users of the castings, and also of the inspection societies, in addition to the more intimate interests which connect the founder who produces the castings and the engineer to whom they are supplied.

The conference recognised that the production of castings in steel is more difficult than in the more common engineering materials, but it directed attention to a number of cases where the percentage of wasters was unduly high, and it was concerned to learn that the experience with steel castings in the Naval Service was such as admitted the position to be summarised as follows, by Commander Sidgwick:—

"The experience with these castings in the Naval Service has been none too happy, in many cases it has been impossible to obtain the desired article in cast steel, so that eventually some other material has had to be employed as a substitute. In other cases the thickness has been increased to such an extent that one might as well have used cast iron."

Continuing, Commander Sidgwick suggested that there were four logical alternative reasons for this position:—

(1) *The designer was asking too much from the founder.* If so, why did not the latter protest instead of wasting time and money in attempting the impossible?

(2) *The standard of soundness set by the Admiralty for this service aimed too high.* That may be, but the user had the right to set his own standard, and if it could not be fulfilled, then he would probably go on to another material and endeavour to have his standard fulfilled with that.

(3) *That the founder had not fully explored the possibilities of his art* in this particular direction. This appeared very likely in view of the extreme excellence of some steel castings that were produced both here and abroad. If it could be done in one case, why not in others?

(4) *The product might already be up to the required standard,* as witness the very small percentage of rejects experienced in some cases.

At an early point in the proceedings Dr. Pullin described the use of X-ray methods for tracing hidden defects in the castings, and he was able to present a series of examples which showed conclusively that hidden defects of important proportions could be found in certain types of castings.

The case for the founder was presented by Dr. M'Cance and Mr. Jefferson, who described the exact nature of the difficulties they were called on to work under, due to the properties shown by the steel during the time it is fluid, and again whilst it is cooling. It was stated that practically all the defects are traceable to questions of gating and feeding the moulds so as to overcome shrinkage and contraction: but that in some cases the designer asks for parts which do not allow any satisfactory system of feeding. The questions involved in the casting of thin sections were discussed. The general trend of the discussion is reviewed in the following statement under the eight separate headings, as below:—

(1) Commercial interest of cast steel; (2) general requirements and typical defects; (3) production of the casting; (4) thin sections; (5) specifications; (6) tracing hidden faults; (7) conclusions, and (8) further action.

* F.T.J., Vol. 40, pp. 53, 72, 105.

(1) Commercial Interest of Cast Steel.

The mechanical qualities of cast steel compare closely with the forged material of similar chemical composition; the tensile strength at elevated temperatures, and other properties of the two materials have been quoted in the Reports issued by the Department of Scientific and Industrial Research—Engineering Research Reports Nos. 1 and 2 of May and July, 1927. In view of these qualities the user would be willing to substitute steel castings in almost every position where forged steel is being used, and would find immense advantages in the flexibility of form given with the casting.

(2) General Requirements and Typical Defects.

The general requirements in steel castings were summarised by Commander Sidgwick, and he also indicated the nature of the usual run of faults which came under the notice of the Naval Inspection Service.

The Naval requirements for machinery castings were:—(*a*) The designed dimensions must be adhered to throughout the finished article as closely as possible; (*b*) the material must be everywhere homogeneous and of the specified quality, and must be free from internal cavities and cracks; (*c*) the article must be free from porosity, and (*d*) internal stresses must be reasonably absent.

Further, the Naval Inspection Service have reported defects of the following general types:—(1) Blowholes; (2) draws, generally at flanges, or changes in sections (very few are known in bosses); (3) porosity under pressure tests; (4) contraction cracks; (5) sand inclusions; (6) scabbing, and (7) failure in physical tests (comparatively few).

The foundrymen took the view that their real troubles were covered by the two works "drawn" and "torn," and these are the result of insufficient feeding or the effects of certain physical properties of the steel which the founder is unable to alter and which have to be overcome by his experience and art. The foundrymen also drew attention to the general use of the term "blowhole" to describe almost every kind of defect. It was explained that blowholes proper are a comparatively rare occurrence, and when they do occur it is due to the failure of the human element in the foundry. Sand-holes and sand-inclusions come under the same category.

(3) Production of the Casting.

The pouring temperature of molten steel approaches closely on the fusing temperature of the moulding sands and causes certain limitations in the methods of moulding. In addition the contraction allowances are about twice that required for cast iron, that is, the contraction while in the liquid state is twice that of cast iron, and again, during freezing it is again twice that of cast iron, and, finally, during cooling the case of cast iron is favourably assisted by modifying expansions, which are not met with in cast steel. Thus the characteristics of the steel, during solidification and subsequent cooling, made it impossible to avoid a tendency towards local weakness at all changes in the sectional thickness of the casting: The thicker section cooling more slowly, and being then damaged by the other parts drawing away the material from the heart of the thick portion. In practice this detrimental influence dictates the position in which the part will be moulded, and in the more complicated castings it leads to the provision of additional heads to feed the thick portions.

This tendency to draw is so very real that it is almost impossible to promise that a casting will be of entirely uniform composition; the Izod values and tensile elongation tending to become reduced at all changes in the section. It was pointed out that even in the case of a simple 1-in. test-bar the core-material would be superior with a side head on the bar, instead of the usual end feeding head; but, in practice, it is almost impossible to work out an ideal system of feeding the more complicated castings, and each casting has to be separately considered.

The extent of the porous material in a simple rectangular billet casting was given by Dr. M'Cance in a graph; this showed that 50 per cent. might have to be cropped from a billet two diameters in length. Thus, in order to secure sound material in a casting it is necessary to provide large gates and headers, and it is only by working in this direction that the moulder can improve his product. As the cost of these extra heads had to be included in the price of the casting, it would seem that the skill of the moulder lies in deciding which of the desirable heads can be omitted without leading the purchaser to find reason to reject the casting as being defective.

(4) Thin Sections.

Experiences were quoted where a design had to be increased in thickness before a satisfactory casting could be obtained, and in some cases the thickness became so great that the part might as well have been made in cast iron. Here the defect showed as a hot-tear, where the restrictions imposed by the mould caused internal stresses during the early part of cooling, when the solidifying steel has such a low strength and ductility that the stresses were relieved by fracture. These fractures may become difficult to locate in the finished casting, as they close again with the cooling of the heavier sections. Here the founders took the view that all progress towards thinner sections was a matter of experiment, and that much could be done by the breaking of the core-irons shortly after pouring the steel. Evidently it is largely a matter of obtaining a softer material for use in the moulds, and there would appear to be scope for investigating the remark that the Continental foundries are able to use about twice the allowance for contraction which obtains in this country.

(5) Specifications.

The founder finds in the case of castings whose forms lend themselves to the moulding process, that there is no difficulty in running a steel of relatively high-tensile strength, and he, therefore, regards it as confusing to be asked to work to such a series of specifications as are quoted below, where there is a considerable amount of overlapping between the different tensile strengths. Further, the view was expressed that there can be no sound reason behind the rejection of a casting on the ground that it is too strong, where the tensile strength falls slightly above the upper limit and all the other properties fall within the specification.

Range of Specifications:—

(*a*) 26-32 tons per sq. in.
(*b*) 28-32 tons per sq. in.
(*c*) 30-37 tons per sq. in.
(*d*) 35-40 tons per sq. in.
38 minimum.

Here it was suggested that 34/36 tons minimum, with 15 per cent. elongation, would provide a suitable standard specification which would meet all the requirments of the above range.

Again, the specifications of the Admiralty and of Lloyd's show the same strength but differ in the other particulars:—

	Admiralty.	Lloyd's.
Tensile, ultimate tons ..	26/35	26/35
Elongation on 3 inches ..	15 per cent.	20 per cent.
Bend	60/90 deg. on 1 in.	120 deg. on 1 in. × ¾ in.

(6) Tracing Faults in Castings.

The source of the faults in the castings arises from a failure to obtain solid material, due to voids, porosity and tears; and while, in the past, it has been usual to pass the castings on the basis of an external inspection, and possibly a further water-test, it has now been found that new methods of inspection bring out further concealed defects of which there is no evidence on the surface. The search for these internal discontinuities makes use of the X-ray methods brought forward by Dr. Pullin, and of another method which discloses changes in the electro-magnetic properties of the part in the vicinity of a local fault. In the case of neither method can it be said that the process of inspection lends itself to routine use in a foundry, but they have given results of considerable practical importance and their use must be expected to extend in the future. On this subject the founder pointed out that while the methods disclose additional defects, these defects are located in positions where they were most likely to occur, and the inspection methods cannot lead to any important change in moulding practice.

(7) Conclusions.

The founder was agreed that casting could be made to Admiralty requirements; but in the more complicated forms the cost would be much higher than that of routine castings.

The founder finds that he has little or no choice in the physical properties of his metal and he feels that the designer, who always has some choice in the nature of his design, does not fully appreciate that point.

It was suggested that the designer and founder should co-operate at the design stage so that the experience of the latter might lead to the design being free from the more prominent difficulties in moulding, while being equally serviceable for its duty; also that the technique of the chemist and metallurgist should be utilised by both designer and founder.

It was suggested that this co-operation could be attained by the formation of a consultative committee consisting of engineers, foundrymen and metallurgists, such a committee to be of local connection rather than of national standing.

(8) Further Action.

The following points brought forward by Mr. Richardson would appear to provide a basis for any future discussion:—

(1) What prospect is there in obtaining steel castings to meet the requirements put forward by the Admiralty that will pass the inspection described?

(2) Can thinner steel castings be produced that are sufficiently reliable to be used in place of iron castings?

(3) Could the varying degrees of complication in castings be met by varying the composition of the steel?

(4) How can the engineer best co-operate with the founder? Should there be some central authority or clearing-house to deal with the various problems with which the engineer and founder are beset?

Reply to Discussion.

Dr. M'Cance wrote that he considered the general discussion which the Papers had aroused had been valuable and enabled anyone who wished to take a comprehensive view of the situation to see more clearly the direction in which progress was tending and to recognise the factors in steel castings manufacture which were not yet under complete control. But he did not think that it was justifiable to take any despondent view of the present position. It would probably always be the case that the demands of engineers were slightly ahead of the practice of production, since it was a simple matter to increase one's demand but a relatively slow business to increase practical proficiency. But steel founders would welcome all the assistance that could be obtained from the new research methods of Dr. Pullin and were in his debt for the pioneer work he was doing. He hoped that his results as they became available would be given wide publicity.

In the discussion Mr. Adam had raised the question of the value of the hammer test, and he (Dr. M'Cance) thought that for present castings it was of no value at all. A casting would require to be exceedingly bad to fall under the hammer test, and in the detection of unsoundness it was so uncertain in its indications that it was of little use. After all, the chief trouble with steel castings was not the detection of major unsoundness but the detection in otherwise good castings for *specially severe service* of areas of secondary unsoundness which were often of very small extent and which could not readily be seen, and in most cases could not be seen at all by a usual examination from the surface. It was not a case, as some people seemed to think, of the majority of present-day steel castings being bad, but of discussion of the best methods for producing difficult steel castings where the necessities of design restricted the application of known physical laws. That distinction was of great importance and should be borne in mind.

Mr. Robinson had raised an interesting subject in his statement that the contraction allowance for Continental foundries was greater than was usual in this country. This was an indication that their moulds were less rigid and interfered less with the natural contraction of the steel either through the use of green sand or better-prepared dry sand. There should consequently be a greater freedom for hot tears, which arose from this cause. He was glad that the conclusions reached by Mr. Gillot as the result of his work at Woolwich corroborated the point of view put forward in his Paper. Seeing that on fundamental questions there was agreement, the chances of satisfactory developments from the research work in progress was most hopeful.

He regretted if he gave Dr. Donaldson the impression that successful steel castings could only be made in the simplest types, for that was far from the truth and was not his opinion.

The uncertainty of the contraction in certain difficult castings arose from the conditions that owing to design it was not possible to make the mould sufficiently collapsible so that the casting had to stretch in cooling down. Exactly how much contraction and how much stretch to allow for could only be decided by making a casting. Yet this question had to be decided by the patternmaker long before the casting had reached the foundry stage. This illustrates merely one of the uncertainties which made the application of rigid scientific principles to foundry work so difficult.

Steel Castings Symposium for Middlesbrough Convention.

The Literary Committee of the Institute of British Foundrymen have decided to organise, in connection with the next annual meeting of the Institute of British Foundrymen, to be held in the Middlesbrough area next June, a symposium on steel castings. Many prominent steel foundry managers and metallurgists are being asked to contribute short Papers.

Welsh Founders' Smoking Concert.

The Wales and Monmouthshire Branch of the Institute of British Foundrymen opened their Session with a Smoking Concert at the Railway Station Hotel, Cardiff, on October 5.

Addressing a large gathering, the Branch-President, Mr. W. S. Kinsman, thanked the meeting for the honour which had been conferred upon him. To be a member of such an Institute meant much, for there was no individual benefit offered, but many sacrifices were made in order that all might give of their best for the advancement of the foundry industry.

The South Wales membership includes both scientific and practical men, ranging from the professor to the artisan, who, during their daily toil, are studying and endeavouring to overcome numerous difficulties. The results are disclosed at meetings held during the winter months in the form of Papers and discussion. All give freely of their knowledge for the benefit of others.

Mr. Kinsman referred to the exchange of Papers with Continental and American friends, which had given much food for thought and helped to cement good feeling and mutual understanding between nations in the industrial world. The South Wales Branch was fortunate in securing a varied programme. Let us therefore go forward, said Mr. Kinsman, and make ourselves efficient in order that we might help to overcome some of the difficulties and make the world a little better than we found it ourselves. If those who were not already members of the Institute would join and put their heart and soul into its work, a step would be taken in the right direction and some of the lost trade might be reclaimed.

A good musical programme was provided, the meeting expressing its warmest appreciation of the untiring efforts of the Hon. Secretary of the Branch, Mr. J. J. McClelland.

Metallurgical Training.

Suggestions with regard to the training of metallurgists were made by Mr. W. C. Gray, in his presidential address to the Birmingham Metallurgical Society on Thursday last. Mr. Gray commented on the decreasing number of students presenting themselves at the universities for training in the metallurgical departments. Industry would, no doubt, be faced with a shortage of trained men. There were many firms which would benefit greatly by the introduction of a competent metallurgist to their organisation, but it should be remembered there were also many which for several years had well-equipped laboratories under the control of qualified chemists and metallurgists. In those laboratories were trained relatively large numbers of technical assistants, who supplemented their works-laboratory training by attending evening classes at technical schools, and who, in many cases, became highly competent. If they considered the process by which their science had become firmly implanted in industry, they found that many firms foresaw the advantages of analytical control of their raw materials and finished products, while others installed a laboratory in order to meet the requirements of their customers. Some firms looked upon the chemist as an expense and did not hesitate to dispense with his services when trade was bad. This practice was a rather common occurrence at one period and had not completely disappeared. Did the present training meet with the approval of industry? The question would not be answered until the universities and the industry got together and discussed the problem.

The I.B.F. in Scotland.

MR. WINTERTON'S PRESIDENTIAL ADDRESS.

The opening meeting of the session was held in the Cadora Restaurant, Glasgow, on October 5. Mr. J. Longden, the retiring President, in the chair.

Mr. Longden, in opening the proceedings, said that this was the first ordinary meeting of the session, yet it was not an ordinary meeting because they had for the first time in the history of the Branch a large number of ladies present. All connected with the administration of the Branch were anxious to extend the popularity and usefulness of the Institute, and Mr. Winterton, the President elect, had attempted to solve the problem in his own way, he wished him every success. He had now the pleasure of introducing to them the new President. He felt sure that all members appreciated the work which Mr. Winterton had done not only for the Scottish Branch but also for the whole of the Institute of British Foundrymen. He was a member of the General Council, where he had done yeoman service for other branches as well as the Scottish. He had also done representative work for the Institute in other countries. There could be no doubt that he had the welfare of the Institute at heart, and under the presidency of Mr. Winterton the Scottish Branch should prosper. He had now the pleasure of introducing Mr. Winterton as the Branch-President and bespoke for him the same hearty welcome and support that had been accorded to himself.

Presidential Address.

Mr. Winterton then took the chair and thanked the members for the honour that had been done him in selecting him as the President of the Scottish Branch. He delivered his presidential address, in the course of which he said, Mr. Longden, ladies and gentlemen, I do not intend to review at length the work of the Institute of British Foundrymen, or, as we used to know it, the British Foundrymen's Association. Commencing under not too glorious auspices in 1904, and headed by that well-known Scot, who now has passed away, Mr. Robert Buchanan, who became the first President, the Institute has carried on an excellent work throughout the intervening years. The international character of the Conference in London last June, the distinguished honour shown to the Institute and its guests by the ancient City of London, through its magistrates and high officials; the wonderful attendances at the Exhibition at the Agricultural Hall, and the popularity of the various lectures delivered by men from all countries at the Institute of Mechanical Engineers at Westminster, all tend to prove the growth of the movement and the keen appreciation with which it is viewed by the learned societies of all countries, by leaders of thought in the foundry trade, by the largest employers of labour connected with the trade, and last, but by no means least, by the rank and file from the shops themselves.

The Position in Scotland.

How are we progressing in the Scottish Branch? Are we quite satisfied? Is every individual member doing his best to further the interests of the Institute, and, incidently, the interests of the trade? How many members in front of me to-night can say that they have been so keenly interested that they have introduced at least one new member during the past year? In the early stages of the Association I knew full well how difficult it was to get new members, and the negative replies to my suggestion to join at that time were far in excess of the affirmatives. At the present moment there are 230 active paying members in the Scottish Branch of the Institute. Two hundred and thirty employers, directors, managers, chemists, foremen, patternmakers, moulders and juniors in the whole of Scotland. Yet everybody is agreed as to the enormous educative value of the Institute. The men in the street, that is, the foundry street, if they were asked, would almost unanimously say that the Institute is doing a good work, yet only 230 members to-day are active paying subscribers of the Scottish Branch. Every effort is made to provide lectures and talks of an instructive, not to say educative, character. During the coming session we are to be favoured with practical and technical Papers given by men who are experts in their particular lines and preeminently capable of dealing with the respective subjects. The provision of such a programme is a most difficult task, and I would like to acknowledge at once the ever-present zeal of Mr. John Bell, who so readily and indefatigably devotes so much care and attention to the well-being of the Branch.

Apprenticeship Recruitment.

One of my predecessors in this presidential office referred to the matter with some diffidence, but I make no apology for speaking once more on the subject of the juniors. My good friend Mr. Affleck designated it a hardy annual. I think it is even a perennial. I find on reference that many addresses on the subject have been given since the formation of the Association, and in 1911 there were no fewer than eight lectures having special bearing on this matter. Our present President, Mr. Wesley Lambert, gave a most interesting address ten years ago, and the General Secretary, Mr. Makemson, not only delivered a special lecture in the following year on the question of apprentices, but before the Birmingham Branch, in 1917 I think it was, devoted considerable space to an excellent Paper entitled "Training the Young Foundryman." Well-known members of the Institute, like Mr. F. J. Cook, Mr. Campion and Mr. J. Shaw, have shown their interest in the matter by delivering lectures from time to time. In fact, the subject is one which, owing to its great importance, is an ever-present matter of deep interest, not only in the British Isles, but in other parts of the world. Only last month I saw in the "Canadian Foundryman" a most interesting article by Mr. D. A. Hampson, who refers specifically to the advisability of endeavouring to make the foundry attractive to boys if the craft is not to suffer in the long run by a shortage of skilled workers. Mr. Hampson is of the opinion that cleanliness will do more to make the foundry attractive than anything else, and he puts the matter very clearly when he says that cleanliness means plenty of daylight, real ventilation, modern toilet facilities, and some place to put clothes besides putting them on a pile of box parts thick with dust. I agree with what the author has so clearly laid down, and it is satisfactory to know that day by day more and more employers are coming to the same conclusion.

The Junior Section.

In Scotland, in connection with this Branch, we have a Junior Section, and I should like to hear that it is going to be more fully supported during the coming session than it has been in the past. The start was one of much encouragement to the Seniors, but I am afraid it is not quite so successful to-day. Why is this? Is the junior foundryman lacking in initiative? Is he content with his present position, or does he desire to improve in the technique of his trade to such an extent that his own position in the world can be considerably enhanced? This suggested improvement can only be brought about by the expenditure of some effort by the junior himself. He cannot complain to-day that the large firms do not afford him many facilities for study and general improvement. Even smaller firms are usually quite willing within their means to do their utmost for the benefit of their juniors, which in time means the benefit of the firm itself. If I may be pardoned for making a special reference, I may say that juniors in connection with my own firm not only have the time off for study, but under certain conditions their fees are paid at the Continuation Classes, and they are encouraged to improve their technical knowledge in every direction. Here again the ladies may help. I am sure they would rather have their sons studying for their improvement in after-life than aimlessly wandering about, spending all leisure time in recreation, and perhaps more than ought to be spent in visits to picture-houses and other forms of amusement. Let it not be thought that I am in any way decrying the benefits of athletics, amusements, or general recreation. On the contrary I firmly believe in the old motto that "All work and no play makes Jack a dull boy." But there is reason in all things, and I should be the last to excuse a boy who spent the whole of his spare time in recreation and none at all on study for the betterment of his future. After all, it cannot perhaps be a surprising feature that boys show some reluctance to enter the trade as a moulder. There seems to be nothing romantic about the formation of moulds on the floor, handling black sand day after day, sometimes in very depressing circumstances of weather and surroundings, so different in fact from the intriguing character of the work of the engineer or the electrician. Yet the foundry must necessarily be the basis of the engineering trade, and it certainly requires a very skilled man to become a successful moulder. Skilled, not only in the application of his hands, but in the exercise of necessary brain power to think out the problems with which he is confronted day by day in a manner undreamt of in the mechanical efficiency generally connected with the engineer and the electrician. To these latter problems may come, and their solution is probably a matter of applied mathematics, but the moulder has recourse in many cases wholly and solely to the exercise of his own wits to devise some scheme whereby an almost impossible problem is reduced to practical development, and eventually, by the finished casting, presents a triumphant solution to the most difficult proposition.

There is much routine work, of course, as in all trades, and possibly much wearisome repetition. I believe, however, notwithstanding expressions I have heard to the contrary, that lads will endeavour to improve their knowledge if opportunities to do so are placed before them in an attractive manner. I believe that this Branch, with its Junior Section, is doing real good work to solve this problem, and in this connection I would like to mention the Buchanan Medal which last year was instituted to encourage junior members, not only to attend the meetings, but intelligently to absorb the knowledge there set forth and reproduce their impressions at the end of the year. Possibly owing to the short notice last year, only one Paper from Scotland was submitted. This year I sincerely hope there will be keen competition amongst the juniors of the Scottish Branch for the possession of the very handsome medal which is to be given year by year. To those who did not know Mr. Buchanan I may mention that he was a Scottish foundryman of considerable repute, who was in charge of the Soho Foundry of Messrs. Avery for many years, and subsequently was director of a business in Walsall, and who, from the time he became first President of the British Foundrymen's Association, took the keenest and warmest interest in the well-being of young foundrymen who came under his notice, not only in his own works, but in the works of other members of the Association.

Continuation Schools—General or Technical.

Looking at the position of the junior from a very broad standpoint, I am inclined to ask

myself whether, after all, successive Governments are doing the utmost in their power to encourage trade development in every possible way. We hear much of the desirability of keeping lads at school for a longer period than is at present deemed necessary. Has it ever occurred to those educationists who profess themselves to be so keenly interested in the welfare of the young, that here is a new field of operation ready and waiting for development? Is it a mere chimerical phantasy or does it come within the range of practical politics? Is it possible to develop a scheme whereby this extra time under tuition, which is deemed so necessary by some for the improvement of our youth, could be spent in practical and technical training in preparation for such trades as they might prefer, and at the same time to continue the ordinary school curriculum of the more advanced character demanded by the age of the pupil. The educational schemes which from time to time are placed before the country certainly do not err on the side of economy, and if we are to pay for the privilege of instructing the young, let us in the name of common sense demand that such instruction shall be given as shall be of some personal advantage to them in after years, and not, as is the case in so many instances, resolve itself into a question of time wasted on unresponsive material from which in years to come there shall be no return. I have in my mind a most excellent school in connection with the foundry trade in France, in which our friend and fellow-member M. Ronceray has taken the deepest personal interest. Could not trade schools of this character be formed, not only in connection with the foundry trade, but in other callings, and, financially supported from public funds, at any rate extend a chance of producing results in the enhanced value of the worker and his generally improved skill in the calling which he has adopted? I can quite conceive that under a scheme of this sort there would be misfits, but I am quite certain that the proportion of failures to successes would not be greater, and would probably be far less, than under the existing system. I feel that in suggesting this solution of the problem before us I am treading on very thin ice, but I would point to the efforts made in other countries to secure efficiency by means of State aid. The tendency to-day is to specialise in certain branches. This must mean that there is even more need than ever for supervision and the provision of supervisors, whose general and all-round knowledge must be of infinite value when controlling establishments divided and subdivided into little watertight compartments whose occupants know little or nothing about the operations of the squad next door, and whose conception of the whole machine is narrowed into a knowledge—expert, if you like—of the correct method of making one small unit.

As I have hinted before, this Institute is doing its very best to provide for the requirements in the direction indicated. I appeal to all members of the foundry trade, to whatever branch they may be attached, to assist the Institute more than ever before in its endeavours to improve the position, not only of the trade, but of all those interested in it. To the large employers of labour, to the managers, directors and those responsible for the carrying on of the various works I venture to appeal most sincerely, and if they are earnest in their endeavour to promote the welfare of the industry, my appeal will not, I am sure, be in vain. To the rank and file of the Institute I also appeal. It is not the easiest thing to arrange a programme which will satisfy the desires of all sections of the members, but the officers of the Branch would, I am sure, welcome any suggestion coming from members, or even outsiders, that would add to the interest and popularity of the movement. The debates could be far more interesting if members would study the various points and endeavour to elucidate them by discussion for the benefit of those of us who have not possibly had the opportunity of studying them in the past.

More Sections Wanted.

I should like to see sections of the Scottish Branch established in the east and in the north, and I am quite sure that we should all be delighted to know that the Falkirk section had increased its numbers to a considerable extent. The work turned out by the Falkirk foundries is renowned all over the world; their light castings have a reputation second to none, and the proportion of really skilled men in that part of the world must be particularly high, yet there are many foundrymen in the Falkirk district who are not, and never have been, members of this Institute. For the advancement of their craft, for the benefit of the youths who are coming on, and for the dissemination of general knowledge of foundry practice, I appeal to them to become members of the Falkirk section and to show by their interest in the general work of the Institute their appreciation of the effort that is being made for the benefit of the craft generally.

Standardising Foundry Supplies.

May I venture, in conclusion, to call special attention to the endeavours that are being made by the Institute to carry out, in conjunction with the British Cast Iron Research Association, investigations of all kinds that present themselves daily in the foundry. I firmly believe that the day has gone, or is at any rate fast disappearing, when individual members of a trade can hold themselves aloof from their fellows and persuade themselves that the information they possess is unique and not to be obtained by others in the same trade. Nothing is to be lost by conference; improvements in all directions must follow if there is a reasonable desire to confer with regard to trade improvements from the technical point of view. Research work of all descriptions is coming into its own, nay, it has already come into its own, and the day is past, definitely and for ever, when rule-of-thumb methods can hold any place in the economic outlook of the foundry trade. I know in my own particular branch this modern trend for investigation is deepening. Standardisation is demanded, and the demand has to be satisfied. No longer is it possible to provide goods which may or may not be up to the previous consignment. A certain quality is required. That quality must be manufactured, and the founder has his own methods of ascertaining whether or not the goods he purchases are up to the standard he requires. As it is with the founder, so it is with the purchaser of foundry goods all round. British goods have always maintained their reputation for excellence, but the foreigner, with his technical education, his desire to provide the purchaser with the exact article he requires, his general tightening up of quality, and above all his ability to provide goods at a cheap rate, make it more than ever necessary for the Britisher to look to his laurels if he is to maintain his place in the forefront in the competition of the world, and to prove that to-day, and for ever, he intends to maintain that position come what may.

Votes of Thanks.

Mr. John Longden, in proposing a vote of thanks to the President, said that it is an unwritten rule that no discussion be permitted of a presidential address, but he thought that the one to which they had just listened showed how interested Mr. Winterton was in the welfare of the juniors, and as it was to the younger members that the future advancement of the industry would be entrusted it was a matter worthy of the most serious attention. He had pleasure in asking them to accord to the President a hearty vote of thanks for his admirable address.

The President then announced that in the competition for the Buchanan medals one of the Scottish juniors had been successful, and he proposed to ask Mrs. Winterton to present the medal to Mr. Norman C. Blythe. Mrs. Winterton then handed the medal to Mr. Blythe. This concluded the business of the meeting.

The members and their lady friends were entertained at a social by the President and Mrs. Winterton. After refreshments the party indulged in progressive whist for an hour and a-half and were then entertained by Miss Niven and Messrs. Robertson and Dorsie.

Mr. Laurie (past Branch-President) proposed a vote of thanks to the singers, which was carried with acclamation.

Mr. John Cameron, past-President of the Institute, in proposing a vote of thanks to the President and Mrs. Winterton for their hospitality, said that Mr. Winterton had not been afraid to break away from the beaten track either in his address or in the nature of the meeting. He said that the President had almost apologised for being an Englishman, but he could assure him that Englishmen of Mr. Winterton's type were heartily welcome in Scotland. He had been much struck by the strong appeal that the President had made on behalf of the junior members, and he thought that it augured well for the future of the Junior Section that the President took so much interest in it. His own son had started work on Monday as an apprentice in the moulding shop as he had done himself, and after hearing the President's appeal he felt bound to direct his boy to become a junior member without delay. He felt that the Branch could not be under the guidance of anyone better than Mr. Winterton, and that great as had been the success of the Scottish Branch in the past it would be immeasurably greater under the present President. He asked them to accord a most hearty vote of thanks to Mr. and Mrs. Winterton for their hospitality. The motion was carried with musical honours.

The Branch-President said that on behalf of Mrs. Winterton and himself he was extremely gratified at the response to their invitation and trusted that everyone had spent a pleasant evening. He hoped that in the near future other functions might be arranged at which the ladies would be invited. He thanked them very sincerely for the way in which they had accepted Mr. Cameron's proposal; he intended to do everything possible to make the Scottish Branch more successful than it had ever been. He wished, before closing the meeting, to propose a vote of thanks to Mr. John Bell, the secretary; no Branch had a better secretary than the Scottish; he had shown loyalty to succeeding presidents, and to himself he had already been of the greatest assistance. The company sang the National Anthem and "Auld Lang Syne" before dispersing.

International Steel Cartel.

Supplementing the information previously published concerning the Vienna meeting of the Managing Committee of the Continental Steel Cartel, it is stated that the reduction in the penalty for excess production which was then decided upon is to apply not only to the German group, but also to all the other groups. It was desired to prevent the penalty question from becoming a disturbing factor when the present feeling seems to be in the direction of the maintenance of the Cartel.

With regard to the recent meeting in Vienna of the Irma (International Rail Makers' Association), it is stated that representatives of the British group made a proposal to raise prices for the last quarter of the year, but that the proposal was not considered. The suggestion is to receive consideration at the next meeting of the Irma, which is to be held in Düsseldorf on December 13. During the discussion in Vienna of the situation of the market, it is stated to have been established that the British group has again exceeded its quota, but this ascertainment did not lead to difficulties, as under the new rules provision is made for the payment of a higher penalty for excess deliveries in order to compensate for the excess tonnage.

High-Test Cast Iron.

By R. P. Lemoine (Paris).

(*Continued from page* 260.)

One may wonder now what is the best way to produce a cast iron with, for instance, 2.5 per cent. final carbon. It is better to use a cupola with very low tuyeres and no bottom receiver at all and run it so as to get 2.5 per cent. carbon in the scrap at the moment it melts down; or is it better to use a cupola with a bottom receiver, run it so as to get 1.8 to 2 per cent. when the scrap melts down and let the iron pick up 0.70 to 0.50 per cent. more carbon in the coke bed of the bottom of the cupola?

When such final carbon is aimed at (as is the case in the described duplex process), the writer prefers the second proposition, because he has discovered that the iron is always more hot and fluid. This is quite understandable, as in the first case the iron has but little extra heat in excess of its melting temperature, whereas in the second case the same extra heat is increased afterwards by at least 50 deg. C., when the liquid iron picks up 0.50 to 0.70 per cent. C and its melting temperature diminishes.

The important question about the use of the second proposition is to know how to regulate the carbon as it is picked up in the bottom receiver. This can be done in at least three ways:—(*a*) Tapping at definite intervals. This may be interesting in practice if the iron is collected in a specially heated ladle, a barrel ladle with a burner, for instance (a fairly expensive solution); otherwise it is not convenient, because the tapping time is not always at the disposal of the cupola man; (*b*) adjust the capacity of the bottom receiver, which has a lining of definite thickness, to the time wanted for the iron to remain in contact with the coke, and tap when the receiver is full. This solution is about the same as the preceding one and also has its inconveniences, and (*c*) up to a definite level, replace pieces of coke with pieces of brick in a hollow bottom receiver. The extra carburisation wanted is performed when the liquid iron drops fall from one piece of coke to the other in the top part of the receiver and ceases afterwards. This solution is probably the best one; it unites the advantage of a carburising receiver of limited capacity to the interest of a naturally hot forehearth or heated ladle. Experience has proved that iron drops can pick up 0.50 to 0.80 per cent. carbon in rapid contacts with pieces of coke when these pieces are free of slag, which is the case in the present instance, as slag falls under the coke bed providing it is fluid enough. Of course, each drop does not always pick up the same amount of carbon, but the average appears to be uniform in practice.

In conclusion, it can be said that, as far as the final carbon content only is concerned, very low-carbon cast iron can be produced in a cupola out of steel-scrap charges only with a good degree of accuracy, and hot enough to withstand fairly long translations to the electric furnace. Such iron, when it comes from rusty scrap, is wild and seems strongly oxidised. This does not matter at all in the duplex process, because a convenient slag takes care of it easily and quickly in the electric furnace; but it is important to consider this fact when trying to get from a cupola a low-carbon cast iron suitable to be cast directly in moulds.

Cupola High-Test Cast Iron.

At this stage of our knowledge, it is natural to wonder if it is not possible to improve substantially the semi-steel process and get, direct from a cupola, cast iron of high and uniform mechanical properties coupled with good moulding qualities. The right technical procedure is well known; reduce the carbon and increase the silicon of semi-steel to get a fine graphite and always the graphite-pearlite constitution throughout widely different thicknesses.

The beginning of a practical solution along this line may appear from what has been said about running the cupola for the duplex process, but the two things are really very different. When working at the cupola for the duplex process, all the efforts are spent to get the uniformity of carbon content of the iron with the safe impression that, in case of failure, the electric furnace is always there to make any necessary correction and only the cost would be affected. There is no worry about silicon, wildness and moulding ability.

Conditions are not the same in the case we are now considering. The iron must be directly hot and fluid enough, not over-oxidised, and must have a fairly uniform silicon content. Extensive experience has shown that good and practical solution can be reached by studying more efficiently the behaviour of the cupola and using selected raw materials.

Fluidity.

It can be seen from the influence of silicon on the iron-carbon equilibrium diagram that this element lowers the temperature of the beginning of solidification. Derived curves show that the "liquidus" temperature is about the same for the two following compositions:—

Carbon 3.0 per cent. and silicon 0.50 per cent. (1)
Carbon 2.60 per cent. and silicon 3.0 per cent. (2)

The first one corresponds to a white heart malleable (cupola product), which is used to cast very thin castings like small fittings, and there is no reason for the second (not very far from a high-test cast iron) not to be fluid enough for common foundry work when it is produced only in a cupola. As a matter of fact, no real difficulty is met along this line.

Oxidation and Uniformity of Chemical Composition.

These two correlative points are most difficult to handle. It has been said that making low-carbon cast iron with a cupola involves in general a fairly strong blast, and this fact increases the importance of the following reactions: When the liquid drops fall in front of the tuyeres, some FeO is formed, as in a converter at the beginning of blowing. If there is practically no silicon in the iron, as is the case at this stage of the duplex process, this FeO reacts on the carbon and gives wildness. If sufficient silicon is present, it reduces a part of FeO and the silica produced unites with the remainder of FeO to form a ferrous silicate, which goes in the slag.

It is a fact that the final iron shows no wildness at all when the silicon is added in the cupola, but this element suffers a more or less severe loss. Variations in the silicon content of the final product come from two principal causes:—(*a*) Heavy and erratic losses during melting, and (*b*) bad mixing of this element in the bottom part of the cupola, if it comes from a material rich in silicon added to the charges.

It must be borne in mind that, as the question is presented here, the final iron must have around 3 per cent. Si and a low carbon (say 2.5 per cent.), and the first idea is to build up cupola charges with soft or mild steel scrap and ferro-silicon. It soon appears when so doing that factors like the size of the pieces of ferro-silicon lead to very erratic losses. The oxidation of the silicon can be reduced to a certain extent and made more steady when the precaution is taken to have a strongly acid slag. Such a slag is interesting, not only because it diminishes indirectly the oxidation of silicon by giving FeO the necessary silica to form a ferrous silicate, but also because it prevents a part of the FeO from picking up silica in the lining of the cupola. It has been noted by the writer that when the composition of the slag is studied and conveniently corrected by additions (like in a blast furnace), the loss of silicon is more steady and the life of the lining is increased up to a surprising figure. Moreover, a strongly acid slag can be obtained very fluid, and this is a valuable feature.

The stabilisation of silicon losses reached by this means is not efficient enough to allow the practical use of an important part of ferro-silicon in the charges. On the other hand, a strongly acid slag has, of course, no influence upon a better mixing of silicon in the bottom of the cupola. Thus, the problem becomes very intricate, but complementary facts are to be considered.

The author had the opportunity to study, some years ago, the carburisation in a cupola of dynamo steel scrap high in silicon. He found that this element lowers the speed of carburisation of steel and makes it almost negligible after a certain point. A low-carbon cast iron can then be produced with a slow melting and a very good uniformity of silicon content by means of this product. Unfortunately, dynamo steel is not at all a common scrap and no industrial process can be based on its use, but has been recognised that 3 or 5 per cent. of silicon in the scrap is not necessary to get a low carburisation speed; 1 to 1.50 per cent. is quite enough, and steel containing this amount is much more available. It is employed in France very extensively by converter steel foundries.

It becomes possible when using this last kind of scrap to increase the final silicon content up to 3 per cent. with high silicon pig-iron instead of ferro-silicon without fearing to get too high a carbon. Table II is the record of a heat performed along this line.

Table II.

Melting capacity of the cupola .. 3 tons an hour
Pressure in the blast box .. .. 400 mm. of water

Composition of charges.

	Weight kgs.	C %	Si %
Pig-iron	100	3.00	5.70
Selected steel scrap ..	150	0.45	1.70
Complete charge ..	250	1.47	3.30
Coke	35	(14 per cent. of metal charge.)	

A strongly acid slag was used.

The resulting cast iron had 2.40 per cent. carbon and an average of 2.90 per cent. silicon with 2.86 and 2.95 per cent. as lower and upper limits. The percentage of scrap in the charges was 60 per cent. The total carburisation was 0.93 per cent. and the average loss of silicon 0.40 per cent. This last figure is not very high, as it corresponds to about 15 per cent. of the original amount.

The analysis of the pig-iron employed should be noted. Such kind of material is produced in France by at least three important blast-furnace companies; it is obviously very interesting in the present case, but during the last few months the production of this type of material has still further progressed. A well-known blast-furnace plant has developed, under the advice of the writer, the direct production of pig-iron with not more than 2.70 per cent. carbon and about 4 per cent. silicon. Experience has shown that this pig can be remelted in a cupola without carburising, and when using it to prepare high-test cupola cast iron a lower percentage of scrap is needed than in the preceding example; 40 to 50 per cent. is sufficient. This is the last stage of the development of the practice in France.

Quality and Cost.

It can be said that the mechanical properties of cast iron prepared with the last process indicated are between the properties of semi-steel and those of electric cast iron. The tensile strength is about 22.2 tons per sq. in., and often more. The metal has a fine graphite due to its

low total carbon, and shows in this respect a substantial difference from a good semi-steel. It also has a fair uniformity of constitution and structure throughout different thicknesses and can compare with electric cast iron from this point of view.

If the cost of this process is now considered, comparison with semi-steel is easy to make. On the one hand, the high silicon pig advocated is slightly more expensive than the low phosphorus pig used in semi-steel (9 per cent. more at the present time); on the other hand, more scrap is used, because the average percentage of scrap in semi-steel is around 20 per cent., and this counterbalances approximately the extra cost of the pig. The comparison with electric cast iron is based on the same considerations already developed about this last product and semi-steel.

If one bears in mind all the preceding descriptions, explanations and comments, one sees that this modern method of production of high-test cast iron with a cupola, after having been first inspired by observations about the duplex process, has resulted, after successive improvements, to resemble the semi-steel process, of which it seems to be a logical improvement. This is probably due to the intervention of many small economic and local or national factors, and anyway, it is a proof of sound industrial interest in France.

The main objection against it is that it seems to need rather unusual raw materials. This is not quite the case, because pig-iron with 2.70 per cent. carbon is not indispensable; it is simply more convenient. If such a product is not available when attempting to adopt the process, some more scrap has only to be added to the charges with eventually up to 10 per cent. ferro-silicon without great danger of getting bad results. On the other hand, steel scrap with 1 to 1.75 per cent. silicon can easily be found in all railway scrap of the world.

Conclusion.

(1) A sound basis of production of high-test cast iron has been the semi-steel process developed during the war. Fairly good mechanical properties were obtained on test-bars, but they were not uniform in any section of a casting, which was a poor feature in the use of such material.

(2) The development of the electric furnace in foundries has given place to the single and duplex processes, giving the first real possibility of adopting compositions with low carbon and high silicon, leading not only to better properties but also to a good uniformity and thence to more reliability.

(3) The careful study of melting steel scrap in cupolas for the duplex process, coupled with the knowledge of the fact that some kinds of scrap have a slow carburisation, have resulted in the establishment of an interesting cupola process. The final product is as uniform and reliable as if it were produced electrically, it being only slightly less resistant.

It is perhaps possible further to improve cupola low-carbon cast iron by taking and treating it in a "jarring" or, better, a "grating"* forehearth. The writer has not yet had the opportunity to make tests along this line; he thinks, however, that in such cases the iron would have to be considerably heated in the receiver, and the price of the operation may easily rise too high.

As a matter of fact, the low-carbon cupola process is not, technically speaking, an improvement on the duplex; its principal advantages are simplicity and ability nearly to replace the duplex when the operation of an electric furnace is too expensive. If it is complicated and its cost increased, it may rapidly become more possible to adopt the duplex process, which is certainly the best of all at the present time.

* The influence of jarring a liquid cast iron on its mechanical properties has been studied by Irresberger, Deschene and others. More recently Prof. Girardet has shown that a "gyrating" motion given to the receiver is much more efficient than simple jarring. See "Bulletin of the Association Technique de Fonderie de Paris."

The results and details indicated here may appear to be of a low standard if compared to what is often published in the technical Press. It is rather easy to get very high figures and splendid results during a test, but when daily practice and routine work are considered, things are not at all as sure and uniform as they appeared to be at first sight.

The author has only intended to place himself at a strictly practical and industrial point of view. For this reason he has put aside all the more or less extraordinary results he came across during the last year instead of considering them as definite improvements. What he has also intended to point out here is the fact that the French production of high-test cast iron has really progressed since he war in the direction indicated by its own previous achievements and a sound technical basis, and that without patented or advertised processes.

Nitriding of Steel.

SYMPOSIUM IN U.S.A.

Nitriding, or the hardening of steel with ammonia gas, was given special prominence at the National Metal Congress, held recently at Cleveland, U.S.A. Among those present, says "The Iron Age," were Dr. Adolph Fry, the originator of the process, and M. Paul Aubert, the promoter of its commercial use outside Germany. We append a few points from the various Papers and discussions.

According to Dr. H. H. Lester, not until nitriding was studied was it really known what caused the hard layer inside large guns after firing. This hardness was caused partly by solution of the nitrogen in the steel. It was possible to have an austenitic-nitride case. This case had possibilities of superior characteristics; it was tougher and more adherent. The austenitic case might be obtained with other than aluminium steels. Dr. Lester expressed the opinion that by proper cooling the case might be martensitic and that it might be tempered subsequently to give desired characteristics. Dr. Lester's views were confirmed by other speakers by their own laboratory work, which indicated that the white layer was due to a solution of the nitrogen.

Dr. Fry said that all results of investigations in U.S. were thus far in agreement with those in Europe. When nitriding was properly carried out, certain hardness with no distortion resulted. The physical properties of the core were not changed, and the hardness and wear resistance were higher than by any other process. Hardness was not injured by drawing even to above 950 deg. Fah., and nitrided parts were free from internal stresses and ageing effects, and were rustless.

Conditions which should be avoided, continued Dr. Fry, were:—(1) Surface oxidation; (2) foreign metals touching the alloy, such as nickel not saturated with nitrogen; and (3) foreign substances in the ammonia, such as air or water.

There was not yet a complete and well-substantiated explanation for nitriding hardness, said Dr. Fry, and the hardness of the nitrided layer was not to be attributed to the hardness of the alloy nitrides themselves. It might be suggested with some assurance that the mechanism of the nitrogen hardening bore some resemblance to quenching and hardening steels in so far as both seemed to be caused by space-lattice distortion.

Practical Problems Outlined.

Among the practical problems of nitriding, which the German inventor enumerated, were:—(1) The necessity of securing more experience in choosing the best alloy for each purpose; (2) machining of nitralloy with even higher core strength without leaving machining stresses; (3) making drop forgings and hot-pressed pieces free of surface oxidation which would otherwise cause inferior quality of the nitrided layer; (4) research on nitriding cast iron; and (5) catalysts as nitriding agents.

Dr. Homerberg's contribution was mainly a study of four steels selected for investigation of the influence of nitriding on the core properties. It was shown that the reduction of impact value was not due to the presence of nickel and that molybdenum as an alloying element was valuable in preventing the reduction of impact resistance. Dr. Harder presented a comprehensive study of the availability of a long series of steels, alloy and non-alloy, for nitriding.

Mr. McQuaid maintained that plain carbon steels could be nitrided just as hard as nitralloy steels. Nitralloy steels could be nitrided commercially so that they were superior to carburised steels, except in machinability. They were all white hard, resisted corrosion, did not distort, and possessed high impact values. There was no loss due to grinding cracks. The steel must be in the sorbitic condition, but nitriding steels required higher temperatures and a severer quench. Mr. McQuaid said he was an advocate of duplex nitriding—at high, and then low temperatures.

New Etching Solution.

Mr. A. B. Kinzel mentioned an etching solution for nitrided steels. It was, briefly, absolute alcohol with enough water to hold copper sulphate and copper chloride in solution, and slightly acid.

Shortening the Annealing Time in Malleableising.

A new short-cycle annealing process for the production of malleable-iron castings is announced by the American General Electric Company. A number of advantages have resulted from the use of the new malleableising process, particularly a saving of many days.

Details of the new method were worked out in the Erie foundry of the American General Electric Company. Three electric annealing furnaces are used for this purpose at the Erie plant, each rated 325 kw. and using nickel-chromium ribbon resistor heating elements. The connections are arranged to allow a power input of 52, 170 or 325 kw. as desired. The capacity of the installation is 100 tons of castings per week.

In operation the hard castings, of commercial composition, are packed on the car bottoms or without iron plates or boxes, depending on the nature of the load. It was found that best results were obtained by stacking the charge directly on the floor of the car.

The charge is then placed in a furnace and heated to a sufficiently high temperature to effect solid solution of free cementite, whereupon the charge is transferred without removing from the car to another furnace for cooling. In this furnace the castings are brought to a temperature below 750 deg. C., which is held for approximately 4 hrs., after which the temperature is suddenly lowered a few degrees and maintained at this lower temperature for another 4 hrs., when this step is repeated. The castings are then transferred either to a cooling furnace or into the air, or they may be quenched immediately with increased strength and without brittleness. The average time for a 6-ton anneal is between 28 and 30 hrs.

Tests taken by the American General Electric Company show that the tensile strength, yield point and other characteristics are practically the same with the short-cycle anneal as with the older methods. It was found that the short-cycle malleable iron machines better than the long-cycle product and shows no signs of framing or reversion. Very little skin is found and the castings clean somewhat easier than the old type of product. The castings may be galvanised without embrittlement and without previous or subsequent treatments. Warpage is also found to be reduced.—"Iron Age."

XUM

The Electrical Conductivity of Magnesite and some other Refractory Materials in Relation to the Temperature and their other Properties.*

By E. Diepschlag and F. Wulfestieg (Technical High School, Breslau, Germany).

(Abstract.)

The object of this research was to examine in electric-furnace practice, at high temperatures a qualitative and quantitative manner the and as affected by the differences in the changes in the electrical conductivity of one of mechanical and chemical properties of the

Table I.—*Electrical Resistance of Magnesite.*

Test number.	Nature of the experiment.	Experimental temperature. 1,100 deg. C.	1,250 deg. C.	1,400 deg. C.	1,550 deg. C.	Remarks.
		Ohms per cub. cm.				
I.	The reproducibility of the results with three different specimens under the same conditions	72,110	31,700	2,500	89.7	Numerical values of three specimens manufactured under the same conditions.
		77,650	31,000	2,400	91.8	
		76,700	30,650	2,350	92.3	
II.	Influence on the results of repeated heating of specimens	111,000	35,000	1,300	93.5	First heating.
		82,100	45,500	1,120	112.0	Fourth ,,
		83,370	49,000	2,100	102.0	Eighth ,,
		143,000	37,600	2,790	92.0	Eleventh ,,
III.	Influence on the results of maintaining the specimens at high temperature for varying periods	83,250	—	3,568	61.2	Heated 1 hr.
		109,000	—	2,947	73.0	,, 2 ,,
		120,200	—	3,450	62.0	,, 4 ,,
		—	—	3,450	62.8	,, 6 ,,
						Pressure.
IV.	Influence on the results of varying the pressure in the manufacture of the specimens	112,650	50,400	2,000	98.0	500 kgs. per sq. cm.
		111,600	35,000	1,300	93.5	1,000 ,, ,,
		73,650	24,180	940	89.0	2,000 ,, ,,
		72,450	20,180	918	86.0	3,000 ,, ,,
		69,050	19,240	905	85.0	4,000 ,, ,,
						Size.
V.	The effect of the size of grains of the specimens	126,700	31,000	2,170	88.0	0.0 –0.08 mm.
		135,200	33,500	2,310	89.0	0.16–0.24 ,,
		141,500	36,900	2,500	91.0	0.48–0.60 ,,
		148,000	39,600	2,680	97.0	0.75–0.90 ,,
		152,000	40,900	2,809	106.0	1.00–1.20 ,,
		154,500	43,400	2,900	117.0	More than 1.20 in.

Table III.—*Electrical Resistance of Magnesite mixed with Pure Materials in Varying Quantities.*

Test No.	Material.	Temperature. 1,100 deg. C.	1,250 deg. C.	1,400 deg. C.	1,550 deg. C.	Remarks.
		Ohms per cub. cm.				Per cent.
I.	Magnesite + MgO ..	113,200	61,350	1,665	111	2 MgO admixture.
		82,550	39,660	1,940	123	4 ,, ,,
		29,215	14,000	1,920	126	6 ,, ,,
		10,150	13,380	2,040	132	10 ,, ,,
II.	Magnesite + SiO_2 ..	107,200	32,700	1,410	123	2 SiO_2 admixture.
		98,750	29,970	1,580	572	4 ,, ,,
		90,000	26,550	1,632	1,080	6 ,, ,,
		73,980	24,210	1,990	2,110	10 ,, ,,
III.	Magnesite + Al_2O_3 ..	105,000	33,000	1,380	180	2 Al_2O_3 admixture.
		54,160	16,750	1,510	290	4 ,, ,,
		28,690	13,000	1,730	330	6 ,, ,,
		15,000	11,170	2,240	984	10 ,, ,,
IV.	Magnesite + CaO ..	101,000	66,250	1,420	103	2 CaO admixture.
		61,420	65,000	2,000	180	4 ,, ,,
		35,000	62,000	3,010	350	6 ,, ,,
		11,100	63,690	2,790	491	10 ,, ,,
V.	Magnesite + Fe_2O_3 ..	62,950	24,900	1,130	92	2 Fe_2O_3 admixture.
		38,000	17,000	1,050	99	4 ,, ,,
		25,500	15,100	926	91	6 ,, ,,
		14,700	1,700	190	55	10 ,, ,,
VI.	Magnesite + Mn_3O_4 ..	66,200	29,100	1,210	90	2 Mn_3O_4 admixture
		46,450	20,630	1,465	83	4 ,, ,,
		22,530	5,000	984	64	6 ,, ,,
		352	193	202	57	10 ,, ,,

the most refractory basic electric-furnace lining materials—magnesite—under the conditions of material. The authors manufactured their own specimens from a good sintering magnesite in common use. By this means uniformity was assured for all specimens. The material was of the following percentage composition: MgO = 87, Fe_2O_3 = 8.10, SiO_2 = 0.8, Al_2O_3 = 0.5, CaO = 2.4, Mn_3O_4 = 0.5.

To determine the influence of the individual constituents on the conductivity of magnesite, pure pulverised materials were prepared and mixed in varying percentages by weight with a certain quantity of magnesite. As it was desirable to obtain a true criterion of the influence on the electrical conductivity of the various constituents these were tested singly in the pure state, and also mixed with each other in certain definite percentages. Besides the effect of the chemical composition, the influence of the size of grain, of the degree of compression, and of the temperature and period of burning, were studied. In particular, the question was raised as to whether repeated burning has an influence. The proportions of the constituents were varied in steps of 2 per cent., and triplicate tests were made on each mixture. The quality of the materials used in each experiment was constant, and equal to a standard quality which had stood the test of practical use.

With regard to its electrical properties, magnesite must be classed with all other known refractory materials as a conductor of the second class. Such conductors are bodies which at the ordinary temperature are non-conducting and show with rising temperature a progressive deterioration of the magnetic field. The changing degree of electrical conductivity depends not only on the temperature, but also upon other physical conditions, such as compression and structure of the brick, and it has, under given circumstances, a value characteristic for the material. A material not absolutely non-

Table II.—*Electrical Resistance of Pure Materials at Different Temperatures.*

Material tested.	Experimental temperature. 1,100 deg. C.	1,250 deg. C.	1,400 deg. C.	1,550 deg. C.	Remarks.
	Ohms per cub. cm.				
MgO ..	158,000	16,395	2,500	1,105	Values of specimen repeatedly heated.
SiO_2 ..	161,000	41,320	12,050	5,950	
Al_2O_3	133,100	58,000	12,000	4,080	
CaO ..	117,740	34,180	10,860	830	
Fe_2O_3..	434	423	—	—	Specimens were reduced.
Mn_3O_4	710	603	—	—	

conducting—such as magnesite—always permits the passage of a certain amount of electric current if there is a difference of electric potential at the ends of the specimen, there being a definite degree of resistance to this flow of current. The authors then describe their experimental apparatus, procedure and results.

Conclusions.

On the whole, the experiments confirm the results hitherto obtained. The most remarkable property is the very great degree in which the electrical resistance depends upon the temperature. With rising temperatures the resistance first falls rapidly, the fall becoming slower at high temperatures.

A constant curve of resistance of magnesite reproducible at will does not exist, because it is apparently impossible to get a material completely homogeneous externally and internally. Therefore, a curve representing the mean value of some experimental results may be considered as the "resistance curve of the material."

The curves of the previously burnt and of the unburnt materials show great differences. The reason is that during the burning process internal transformations take place which influence the electrical resistance until they are completed.

Stable systems of materials show correspondingly regular curves. Anomalies indicate unstable conditions, but these can be removed by burning for a long time. For this reason, all

(*Continued on page* 288.)

* A Paper read before the Annual Meeting of the Iron and Steel Institute.

Mixing, Melting and Annealing Costs for High-Quality Malleable Iron.

By Dr. Rudolf Stotz.

(Translated from "Die Giesserei," September 14, 1928.)

For some years now the expressions "treated cast iron" and "high-quality cast iron" have caught on with foundrymen, with all their good and detrimental repercussions which are the concomitant of technical progress. The industries which produce and consume malleable cast iron have also taken up the cry, and malleable iron foundries are now, more than ever they were, faced with the question: What is the best process for producing high-quality malleable cast iron?

In order to afford comparative data for the selection of the process in new plants or conversions of existing plants, the present Paper will give a brief comparison of the various possible methods of producing high-quality malleable iron. In making this comparison of costs, the same prices will always be assumed for the raw and subsidiary materials. Since, however, these prices may vary from one district to another, due to freights and local conditions, the costs of production as ascertained at foundries in other localities will occasionally deviate considerably from the figures given here, with the result that the cheapness or otherwise of the melting processes compared will likewise vary considerably according to the variations in prices for a given district. In comparing the costs of the several processes, then, the figures set out in this Paper should not be taken as they stand as being applicable to every locality, but the prices for each district should be substituted and inserted in place of the figures here given.

In addition to being governed by the local prices for raw and subsidiary materials, the selection of a given process of production may also be largely governed by the turnover and capital costs; and any appreciable departure from the turnover figure assumed in this Paper will of course also largely affect the production costs.

As the annealing costs are determined to a certain extent by the process of melting adopted, the total cost of a given method of manufacture must be arrived at by adding the annealing costs to the melting costs.

In calculating the costs for the furnace charge, we have assumed an average mixture, and one in which, following the general practice, each foundry always completely remelts its gates, runners, and other casting discard, etc. As these items always constitute a more or less constant percentage—depending on the iron loss and the yield—of the burden in each foundry, and one that is constantly recurring, they have been entirely omitted from the calculations of cost. The differences in the various processes in regard to iron losses, translated into "charge costs," mean that a correspondingly large percentage of "commercial" or "bought" iron must be included in order to produce a "yield of good iron" that has been assumed to be constant for all melting processes—viz., 42 per cent. of the charge.

The conditions laid down in the calculations as regards turnover, iron loss, furnace yields and capital costs are set forth in Table I. The

Table I.—*Assumed Basis for Calculating the Production Costs of Malleable Iron.*

—	Three crucible furnaces.	One oil-drum furnace.	One electric furnace.	One open-hearth furnace.	One coal-fired reverbera-tory furnace.	Two cupola furnaces.	One Brackelsberg furnace.	Two cupolas and		
								One electric furnace.	One oil-drum furnace.	One baby converter.
Furnace capacity	Four crucibles per furnace each holding 0.60 metric ton = 0.240 metric ton.	1 ton	3 tons	5 tons	5 tons	—	5 tons	5 tons	1 ton	2 tons
Melting output per hour ..	0.26 ton	0.36 ton	1 ton	1.2 tons	1 ton	3 tons	1.4 tons	3 tons	1 ton	3 tons
Melting capacity per day ..	2.88 tons	4 tons	12 tons	15 tons	15 tons	15 tons	15 tons	15 tons	8 tons	15 tons
Melting capacity per annum ..	720 tons	1,100 tons	3,000 tons	3,750 tons	3,750 tons	3,750 tons	3,750 tons	3,750 tons	2,000 tons	3,750 tons
Daily time of melting ..	11 hours	11 hours	12 hours	13 hours	15 hours	5 hours	11 hours	5 hours	8 hours	5 hours
Number of melts a day ..	4	4	4	3	3	Continuous	3	3	8	7
Iron losses	2 per cent.	8 per cent.	4 per cent.	8 per cent.	7 per cent.	5 per cent.	1 per cent.	6 per cent.	8 per cent.	12 per cent.
Capital cost	£400	£500	£4,250	£2,250	£1,500	£1,250	£1,000	£5,500	£1,750	£2,750

Table II.—*Comparative Calculations of Production Costs of Malleable Iron.*

Note.—Figures are given in shillings and decimals of a shilling.

—	Crucible furnace.	Oil-drum furnace.	Electric furnace.	Open-hearth furnace.	Coal-fired reverberatory furnace.	Cupola furnace.		Brackelsberg coal-dust fired drum furnace.
						Old process.	New process.	
Charge.	Per cent. s.	Per cent. s.	Per cent. s.	Per cent. s.	Per cent. s.	Per cent. s.	Per cent. s.	Per cent. s.
Duisburg Kupferhütte pig iron at 98s. per ton	34 = 33.32	50 = 49.00	10 = 9.80	50 = 49.00	44 = 43.12	37 = 36.26	22 = 21.56	28 = 27.44
Special iron and additions	—	—	5 = 6.45	—	—	—	5 = 7.80	—
Wrought-iron scrap at 55s. to 70s. a ton	10 = 7.00	—	31 = 17.05	—	5 = 3.50	10 = 7.00	20 = 14.00	15 = 9.00
Runners, risers, etc.	56 —	50 —	54 —	50 —	51 —	53 —	53 —	57 —
1 ton of charge = 0.420 ton of good castings	40.32	49.00	33.30	49.00	46.62	43.26	43.36	36.44
Material costs for 1 ton of good castings ..	96.00	116.67	79.29	116.67	111.00	103.00	103.24	86.76
Melting costs in shillings per metric ton of charge—								
Coke at 31s. per ton	80 = 24.80	—	—	—	—	20 = 6.20	15 = 4.65	18 = 2.16
Coal at 28s. per ton (coal dust at 12s. per ton)	—	—	—	32 = 8.96	45 = 12.60	—	—	—
Fuel oil at 130s. per ton	—	20 = 26.00	—	—	—	—	—	—
Electric energy for melting, 850 units at 0.03s. per unit	—	—	25.50	—	—	—	—	—
Graphite crucibles	30.00	—	—	—	—	—	—	—
Materials for lighting	0.80	—	—	—	0.30	0.50	0.50	0.20
Small items, etc. (electrodes)	2.40	4.00	6.45	2.80	2.50	3.50	3.50	2.50
Lime and fluxes	—	0.50	2.50	0.90	0.50	0.30	0.30	0.50
Furnace maintenance	3.80	4.20	8.50	6.75	4.60	2.10	2.10	0.90
Wages	9.00	5.50	7.50	6.10	4.80	4.00	4.00	2.60
Total = melting costs	70.80	40.20	50.45	25.51	25.30	16.60	15.05	8.86
Depreciation, 10 per cent.	1.11	0.91	2.83	1.20	0.80	0.67	0.67	0.53
1 ton charge = 0.420 ton of good castings	71.91	41.11	53.28	26.71	26.10	17.27	15.72	9 39
Melting costs for 1 ton of good cast iron ..	171.21	97.88	126.62	63.60	62.14	41.12	37.43	22.36

calculations for the charge and melting costs of the processes most usually adopted are given in Tables II and III. It will be seen that, for a moderate turnover, the crucible melting process is the cheapest as regards capital cost, but the most expensive as regards working costs. The method of melting in an oil-burning drum furnace is also a very expensive process, due to the almost fourfold increase in the price of fuel oil as compared with pre-war. The electric-furnace process is also expensive where the cost of current per kw.-hour (unit) is appreciably above a third of a penny. The raw material costs are surprisingly low in the electric furnace, due to the fact that a large percentage of cheap wrought-iron scrap can be included; but, as against this, all other items of the melting costs and the depreciation are very high, besides the high figure for electric energy. These figures could be reduced to a fair extent by running the furnace throughout the 24 hrs. instead, as here assumed, of only 12 hrs. It could be run the other half of the time for melting steel, etc.

The charge of the Siemens-Martin (open-hearth) furnace, like that of the oil-fired drum furnace, is the most expensive of all melting processes, as the melting operations in these furnaces have to be carried on with a large excess of air, and, due to the oxidation effect produced, practically no wrought-iron scrap can be included in the charge lest the carbon content of the melt drop below permissible limits. For many foundries, the Siemens-Martin (open-hearth) furnace has the very great advantage of enabling steel castings or high-quality grey iron to be cast in it when it is not being used for malleable iron, thus still further reducing the cost of producing malleable iron. In districts where, on account of high freights, pig-iron is very dear and scrap comparatively cheap (in South Germany, for instance), the materials costs for the open-hearth furnace are still more adverse as compared with the cupola, the extra price being up to £1 5s. per ton of good cast iron.

The melting costs of the ordinary coal-fired reverberatory furnace, which is hardly adopted at all in Germany but is very widely used in America, are approximately the same as the production costs of the open-hearth furnace, but the reverberatory cannot be used for the production of steel castings. On the other hand, one advantage of the reverberatory furnace is that it requires no attention and fuels where melting operations are held up due to holidays, labour disputes, etc.

The cupola is the melting process that is most widely adopted in Germany. In other countries, such as America, it is absolutely taboo for the manufacture of high-quality malleable castings such as are required in the motor, agricultural machinery and electrical industries, because the view was formerly held that it was impossible to get very tough malleable castings from the cupola. But, just as in the case of grey cast iron, malleable-iron foundries have succeeded during the last few years in producing castings having strength properties which would have been thought to be scarcely possible a few years ago. Tensile tests, carried out in the course of a month on standard test-bars at two different foundries, yielded figures which proved that it is really possible to produce a high-quality malleable iron with certainty in the cupola.

In the calculations given in this Paper, figures are given both for the old and for the new cupola melting process, and these do not differ appreciably. There is, however, a considerable difference in the annealing costs according to whether, following the old process, the castings are heated for a long time at high temperature or whether, following the new process, a short annealing period is sufficient. As the total production cost of a given process of manufacture is governed by the sum of the raw materials, melting and annealing costs, the annealing costs must be considered simultaneously. These figures have been ascertained from practical data, and are set forth as averages in Table IV.

The highest costs are incurred in the annealing process of cupola cast iron made by the old method. Compared with this, the annealing of low-sulphur and carbon cast iron from the open-hearth, crucible, electric or reverberatory furnace can be carried out at approximately 20s. per metric ton less. Due to this fact, the open-hearth furnace formerly had a slight advantage, on the score of cost, over the cupola, which, however, is now approximately wiped out by the high melting cost. As it is now possible, however, to anneal cupola cast iron at about 26s. 9½d. per metric ton lower than what has hitherto been possible with open-hearth cast iron, the former can be produced at 60s. to 70s. per ton cheaper than the latter.

By far the cheapest process of annealing is "black-heart" malleable iron, this having formerly been produced only from low-sulphur cast iron melted in the reverberatory furnace, but which can now be produced from suitably-melted cupola cast iron.

As it is quite feasible to melt in the cupola a crude (untreated) cast iron which can be converted by annealing into high-quality white-heart or black-heart malleable, the processes which consist in refining the cupola iron, and so eliminating the bad effects of a high-sulphur and carbon content (see Table III), may now be regarded as having been brought up to date. Formerly, this operation could only be carried out in the electric and oil-flame furnace, together with the baby converter (cf. Table V). A "triplex process" is even being used by two of the biggest malleable foundries in America, the cupola iron being reduced to the lower carbon content desired by blowing it in a converter, and afterwards desulphurised in the electric furnace. This process, however, is so complicated and expensive that it could not possibly be used under German conditions in their present state of technical development.

This Paper would not be complete without some reference to a new process of melting by means of coal-dust which has been developed during the last two years by Messrs. J. D. Brackelsberg, of Milspe (Westphalia), and which is certainly destined radically to affect methods of producing cast iron, both technically and economically. By adopting this process it is possible to utilise the cheapest materials for the charge and to get a high-quality malleable iron at a price very much below the cost of melting in the cupola (see Table II). Assuming the process is also used for producing black-heart malleable iron, the total production costs can be cut down to such an extent to give a selling price

TABLE III.—*Costs of Production of Malleable Cast Iron when refining Cupola Iron. The Costs are again given in Shillings and Weights in Metric Tons.*

Melting furnace. Refining process.	Cupola. Electric.		Cupola. Oil drum.		Cupola. Baby converter.	
	Per cent.	s.	Per cent.	s.	Per cent.	s.
Pig-iron at 98s. a ton	15	14.70	25	24.50	46	45.08
Wrought-iron scrap at 70s. a ton	33	23.10	25	17.50	10	7.00
Gates, etc.	52	—	50	—	44	—
1 ton of metal charged = 0.420 ton of good cast iron	—	37.80	—	42.00	—	52.08
Refining costs—	Per 1-ton charge.		Per 1-ton charge.		Per 1-ton charge.	
Electric energy : 300 units at 0.03s. per unit	9.00	—	—	—	—	—
Heating oil (10 per cent.)	—	—	13.00	—	—	—
Small items (electrodes)	2.80	—	2.45	—	3.80	—
Lime and additions	3.70	—	3.00	—	1.70	—
Furnace maintenance	6.20	—	2.10	—	2.20	—
Wages	5.50	—	2.25	—	1.50	—
Service refining costs	27.20	—	22.80	—	9.20	—
Depreciation, etc.	2.83	—	0.60	—	0.80	—
Refining costs for 1 ton of metal charged = 0.420 ton of good castings	30.03	—	23.40	—	10.00	—
Refining costs for 1 ton of good cast iron	—	71.50	—	55.71	—	23.80
Total of charge, melting and refining costs for 1 ton of good castings	—	198.93	—	193.14	—	185.23
Annealing costs for 1 ton of good castings	—	102.00	—	102.00	—	102.00
Total sum of iron costs for 1 ton of good castings	—	300.93	—	295.14	—	287.23
Difference in price compared with the usual cupola cast iron, per ton of good castings	—	+36.81	—	+31.02	—	+23.11

TABLE IV.—*Annealing Costs of the Different Manufacturing Processes.*

Melting or annealing process.	Cupola cast iron.				"White-heart" reverberatory furnace, crucible and similar C.I.		"Black-heart" malleable.	
	Old method.		New method.					
	Per cent.	s.*	Per cent.	s.	Per cent.	s.	Per cent.	s.
Coal at 28s. per ton	140	39.2	90	25.2	120	33.6	60	16.8
Annealing ore at 30s. per ton	30	9.0	20	6.0	25	7.5	5	1.5
Annealing pots at 180s. per ton	23	41.4	15	27.0	20	36.0	5	9.0
Wages	—	25.2	—	23.0	—	20.0	—	10.0
Furnace maintenance	—	5.2	—	4.0	—	4.9	—	2.0
Annealing costs	—	120.0	—	85.2	—	102.0	—	39.3

* *Note.*—"s." means shillings.

that will put malleable castings on an entirely new competitive basis.

The time required for melting a 5-ton charge containing about 15 per cent. of cheap wrought-iron scrap is about 3 hrs.; when the furnace is cold, the first melt takes half an hour longer. The iron loss is very low, tests made at the Kaiser Wilhelm Institute for Iron Research having shown it to be less than 1 per cent. A striking point is the low percentage of iron in the slag, as only 0.15 per cent. of the iron is converted into slag.

During the melting process the slag does not need to be run off, as it does in other reverberatory furnaces, as there is only a thin layer on the liquid iron, this being run off at the end of the melt after the iron. The furnace is discharged by rotating it, thus enabling any quantity to be tapped through the side tapping opening.

The outstanding features of iron melted in this furnace are its fluidity, denseness and low content of gases and oxides, and these properties make for specially good strength figures in the malleable product. Using cheap German raw materials, an average tensile strength of 24 tons per sq. in. with 18 per cent. elongation was obtained. By using a high-quality pure charge the average elongation was increased to about 25 per cent.

It is thus possible to obtain high-quality malleable iron without the use of special added alloys, provided, of course, the usual concomitants of iron are kept in the right proportions. The effect of phosphorus does not manifest in cupola cast iron, although it can in the case of black-heart malleable. Whereas German malleable iron contains only about 0.07 to 0.1 per cent. P, the Americans admit as much as 0.225 per cent. P, *i.e.*, about twice the percentage. Since slight increases in the phosphorus content (up to approximately 0.25 per cent.) increase the tensile strength, the American black-heart malleable will have a tensile strength of from 1 to 1.25 tons per sq. in. higher than that of German black-heart malleable. Since each increase of 0.1 per cent. in the silicon content increases the tensile strength by about 0.6 ton per sq. in., the tensile strength of cupola cast iron can be increased by about 1.9 tons per sq. in. by increasing the silicon content from 0.5 to 0.8 per cent., and the tensile strength of malleable iron by about 3.17 tons per sq. in. by increasing the silicon from 0.7 to 1.2 per cent. Each increase in the manganese content of approximately 0.1 per cent. increases the tensile strength by about 0.50 ton per sq. in.; so that the tensile strength of cupola cast may, if required, be increased from about 21.5 tons with 0.1 per cent. manganese to about 25.4 tons per sq. in. by increasing the manganese content to 0.8 per cent., whereas in malleable iron the manganese can only be increased from 0.1 to 0.3 per cent. with an increase in tensile strength of about 1 ton per sq. in.

The greatest effect is that of the percentage of carbon in the untreated castings. Whereas a very high carbon content, *e.g.*, 3.3 to 3.6 per cent., was the normal practice previously, both in reverberatory and cupola cast iron, recent knowledge has resulted in a considerable reduction of the carbon content. By such a big reduction of the carbon content of, say, from 3.6 to 2.8 per cent. it is possible, other conditions remaining the same, to increase the tensile strength of cupola cast iron by 6.3 tons per sq. in. To quote another example, reverberatory cast iron can be decreased from 3 to 2.4 per cent. in the carbon steel, with a corresponding increase in tensile strength from 24.7 to 29.2 tons per sq. in.

These few brief notes are intended to show the importance and necessity of exercising a strict check on the chemical composition of malleable cast iron (*i.e.*, untreated). Any money expended by a foundry on investigations of this kind will be more than recovered by the improved quality of their products, the cheaper raw materials used and a very cheap annealing process adequately adapted to the chemical composition. Many malleable-iron foundries are slow to progress, but the sooner they start to utilise the latest technical progress the better they will be equipped to compete with the drop-forging works and the light-castings trade, both at home and in the highly-competitive markets of the world.

TABLE V.—*Comparison of Production Costs of "White Heart" and "Black Heart" Malleable Iron with different Melting Processes, in Shillings per Metric Ton of Good Castings.*

Type of casting.	"White-heart" malleable iron.											"Black-heart" malleable.	
Type of furnace.	Crucible.	Oil drum.	Electric.	Melted in cupola and refined in			Open-hearth furnace.	Coal-fired reverberatory furnace.	Cupola furnace.		Brackelsberg coal-dust drum furnace.	Open-hearth.	Brackelsberg.
				Electric furnace.	Oil-drum furnace.	Baby converter.			Old process.	New process.			
Raw material	96.00	116.67	79.29	90.00	100.00	124.00	116.67	111.00	103.00	103.24	86.76	116.67	86.76
Melting costs	171.21	97.88	126.67	37.43	37.43	37.43	63.60	62.14	41.12	37.43	22.36	63.60	22.36
Refining costs	—	—	—	71.50	55.71	23.80	—	—	—	—	—	—	—
Total	267.21	214.55	205.91	198.93	193.14	185.23	180.27	173.14	144.12	140.67	109.12	180.27	109.12
Annealing costs	101.90	101.90	101.90	101.90	101.90	101.90	101.90	101.90	120.10	85.20	101.90	39.30	39.30
Total melting and annealing costs	359.11	316.45	307.81	300.83	295.04	287.13	282.17	275.04	264.22	225.87	211.02	219.57	148.42
Difference compared with usual cupola practice	+ 94.89	+ 52.23	+ 43.59	+ 36.61	+ 30.82	+ 22.91	+ 17.95	+ 10.82	± 0	— 38.35	— 53.20	— 44.65	— 115.80

Discussion.

Director Meyersberg said that, according to the author, the outstanding advantages of the Brackelsberg furnace appeared to be:—(1) Protection of the furnace lining, (2) clean products and (3) low-melting and production costs. He would, therefore, like to have further information as to the fuel consumption and the unit price of the fuel used?

Dr. Stotz replied that a coal containing 12 to 14 per cent. ash and 10 per cent. moisture was used, which cost about 9s. to 10s. a ton where the furnace was installed. The cost of grinding the coal was approximately 9d. a ton, thus making the normal price of the coal 11s. a ton. These are figures that are approximately in the same ratio to the coal price which he had set down at 28s. a ton. The drum furnace uses very little coal. It would be about 0.31d. per ton for melting, even if the coal cost 15s. instead of 12s. a ton. The advantage of the furnace is that both damp coal and coal containing a high percentage of ash can be used. There is no need to dry the coal before use, experience having shown that a coal containing up to 10 per cent. moisture can be used.

Dipl.-Ing. Klüser (Elberfeld) confirmed what Dr. Stotz had said. He found the quality to be excellent. He had also had castings made in the drum furnace malleablised for two to three days, and found that the carbon content had dropped to 0.1 to 0.15 per cent. in this short time. Dr. Stotz made his inquiries regarding the old cupola process he mentioned from 1½ to two years ago. It was usual at that time to make malleable castings with a low percentage of manganese. For nearly a twelvemonth malleable iron foundries have been adopting a manganese content of 0.2 to 0.3 per cent. simply because the Kupferhütte pig-iron is supplied with about 0.3 per cent. manganese. Experiments that have been continually going on have shown that this enables the malleablising period to be considerably curtailed, and the elongation figures generally lie between 4 and 8 per cent. More recently, figures of between 10 and 11 per cent. have been obtained in the cupola.

The Electrical Conductivity of Magnesite and some other Refractory Materials in Relation to the Temperature and their other Properties.

(*Continued from page* 285.)

unstable materials require a certain minimum burning time. For the magnesite used in the authors' experiments, the minimum burning time was found to be about 26 hrs. at a temperature of 1,550 to 1,560 deg. C.

At every temperature, if it is maintained long enough, an internal stable condition is reached, which can be expressed by constant values of resistance. The period of heating differs for different ranges of temperature, and this is useful in helping to determine the duration of the reactions. The difference between the first curves and the final curve probably gives a correct idea of the intensity of the reactions.

An increase of pressure in manufacturing the specimens reduces the values. No doubt there is a relation between pressure, size of pores in the specimen and resistance, but this cannot be definitely determined.

By changing the chemical composition it is possible to change the values of resistance as well as the form of the curve.

There is an important difference in the course of the curves of light and dark oxides. MgO, SiO_2, Al_2O_3, and CaO have nearly straight line curves at temperatures over 1,500 deg. C. Fe_2O_3 and Mn_3O_4 have curves which drop suddenly at lower temperatures.

The resistance curves may be arranged in the following order: SiO_2, Al_2O_3, MgO, CaO.

The addition of white oxides, especially SiO_2 and Al_2O_3, tends to lower the electrical resistance of common magnesite.

Table I shows the electrical resistance of magnesite at different temperatures, Table II shows the electrical resistance of pure materials at different temperatures, and Table III shows the electrical resistance of magnesite mixed with pure materials in varying quantities.

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Trade Talk.

An engineering exhibition is to be held in Bradford from November 6 to 16.

The dispute at the British Mannesmann Tube Works, Landore, Swansea, remains unsettled, although a certain number of the men are at work.

Steam Plant Accessories, Limited, 38, Victoria Street, London, S.W.1, have resigned from their representation of Messrs. A. Turnbull & Company, Limited, Glasgow, as from September 30 last.

Messrs. Robert Stephenson & Company, Limited, Darlington, have received an order from Buenos Ayres for 12 three-cylinder compound passenger tank locomotives. The engines are to be of the 4-6-4 type.

The Underfeed Stoker Company announce that they have secured the sole manufacturing rights for Vibro conveyors under the Schenck-Heymann system, the conveyors being manufactured entirely at the company's works at Derby.

Messrs. Barclay, Curle & Company, Limited, Whiteinch, Glasgow, have received from the Vestfold Whaling Company, Sandefjord, Norway, an order for a motor tanker of 9,400 tons deadweight, delivery to be given in November, 1930.

The Ailsa Shipbuilding Company, Limited, Troon and Ayr, have received an order from Messrs. William Sloan & Company, Limited, Glasgow, for a steel-screw steamer, 246 ft. long, 36 ft. in breadth and 17 ft. in depth. The builders will supply the propelling machinery.

Messrs. Scott's Shipbuilding & Engineering Company, Limited, Greenock, have received an order for a motor-driven passenger vessel for London owners. The machinery will also be supplied by Messrs. Scotts.

At the monthly meeting of the Motherwell and Wishaw Dean of Guild Court, linings were granted to Messrs. John Black, Limited, for the reconstruction of the engineering works in Park Street, Motherwell, previously occupied by Messrs. Chambers & Scott. The works were destroyed by fire some years ago and have since remained closed.

The Friedenshütte A.-G., Friedenshütte, Upper Silesia, Poland, one of the most important steel plants in that country, has reorganised and expanded its capacity. The company has added six open-hearth furnaces, which will raise its output from 150,000 tons a year to more than 300,000 tons. Five of the furnaces are now in operation, and the sixth, a 60-ton furnace, will be started this month.

Messrs. John A. Smeeton, Limited, of 15, Victoria Street, Westminster, London, S.W.1, announce that they have appointed Messrs. Swan Brothers, of 3, Exchange Place, Middlesbrough, as their sub-agents for the sale and exploitation of all foundry plant and equipment as manufactured by the Badische Maschinenfabrik, of Durlach, in the Northumberland and Durham districts. They will also deal with the "Collin" patent ladles and the "Steinert" electric lifting magnets.

In his presidential address to the Institution of Engineers and Shipbuilders in Scotland, Sir James Lithgow, Bt., said that industrialists in the West of Scotland must, in his opinion, look to what had become known as rationalisation to give them time to recover their profitable trade. Unless and until trade did become profitable it would not expand. He believed that those in control of most West of Scotland industries realised that some such process was immediately necessary. Only after the works which were in operation were being carried on at a profit could they hope to finance the running of further plant.

An important move towards the formation of a new group in the United States steel industry, under the banking auspices of Otis & Company, is reported by cable from New York, where official announcement was made last week of the acquisition by the Central Alloy Steel Corporation, of Ohio, of the Interstate Iron & Steel Company, of Chicago. This merger, which brings the assets of the Central Alloy Steel Corporation to a total of over $92,000,000 (£18,400,000), is regarded by the steel industry as a nucleus for a big consolidation of alloy and special steel concerns to be formed later with the backing of the Eaton-Mather iron and steel interests. The Central Alloy Steel Corporation recently acquired rights to produce in America certain new alloys developed by the Krupp concern in Germany.

Lecturing on the romance of the steamship to the Aberdeen Mechanical Society, Mr. J. R. Melville concluded with a peep into the future. He discussed a skimming vessel for crossing the Atlantic at a speed of over 40 knots, carrying only 150 to 200 passengers. In regard to ordinary liners, the best speed that could be obtained on orthodox lines with present-day knowledge would be 34 knots, carrying about 2,000 passengers. Developments in the immediate future would no doubt be along the present lines, large vessels luxuriously furnished, and passengers would have to choose between high speed and discomfort or a slower speed and much greater comfort. The latter would probably be the dominating factor, except in cases of extreme urgency.

After lengthy negotiations the rating assessment of the Birkenhead shipyard of Messrs. Cammell Laird & Company, Limited, has been fixed at last year's figure of £23,750. A proposal to raise the assessment to £32,688 met with strong opposition, and the firm appealed without success. The Assessment Committee, it is understood, at a recent meeting reconsidered the position of the firm in relation to the depressed state of shipbuilding and the fact that the shipyard employs many thousands of men, with the result that last year's assessment is to be continued. Mr. R. S. Johnson, managing director of the shipyard, stated that the increase would have meant a higher figure for every ship for which they quoted, with the result that they would not have been able to compete successfully with other shipbuilders.

The directors of Messrs. Richard Thomas & Company, Limited, state that the committee which was appointed to advise as to the position of the company's affairs is still occupied in gathering data with a view to a complete study of the business. The committee hope to be able to make some recommendations at the general meeting of the shareholders in December. The directors add that the profits in South Wales are being maintained, and show signs of expansion. The collieries are showing better results than they did twelve months ago. Most of the South Wales profits, however, have been absorbed by interest on the debentures and loans issued owing to the excessive cost of the plant at the Redbourn Works in Lincolnshire, erected during the war, and the cost of maintaining the works during the past few years. The reconstruction of a portion of the Redbourn plant and the restarting of it after four years' idleness has taken some months longer than was anticipated. The directors feel confident that their decision to restart that plant will be justified, but it has not been in operation long enough to prove the possibilities by actual results.

The directors of Dorman, Long & Company, Limited, and Bolckow, Vaughan & Company, Limited, have arrived at a provisional agreement for an amalgamation of the interests of the two companies. Dorman, Long & Company, Limited, and Bolckow, Vaughan & Company, Limited, are parallel with each other in equipment, in control of the raw materials of steel production and in the markets they supply. Amalgamation between them offers important advantages in addition to the general benefits to be derived from consolidation. Their joint power of production will be based upon a well-balanced supply of raw materials and a more efficient use of plant. Concentration of work in the most economical units, with the consequent reduction in cost, will enhance the earning powers of the combined concern. Expenditure upon future development will result in greater efficiency and economy, since it will be undertaken by a single company and not by two competing units. Co-operation between the structural business of Redpath, Brown & Company, Limited, which is controlled by Bolckow, Vaughan & Company, Limited, and the bridge-building and structural business of Dorman, Long & Company, Limited, will assure to the joint concern a predominant position in constructional engineering.

New Companies.

Gateshead Foundry, Limited.—Capital £1,500. Secretary: W. G. Robinson, 56, Oxford Street, Whitley Bay.

Repton Foundry, Limited, Britannia Street, Tividale, Tipton, Staffs.—Capital £10,000. Directors: W. W. Lawley and Mrs. A. Lawley.

W. F. & M. Webb, Limited, 89, Bartholomew Close, London, E.C.—Capital £3,000. Engineers' merchants, etc. Directors: C. E. Spivey and A. C. Dew.

Roe & Wilders, Limited, 89, Leopold Street, Birmingham.—Capital £3,000. Manufacturers of metal fittings, etc. Directors: F. Clews (chairman) and F. Clews, junr.

Personal.

Mr. Harold E. Midgley, director, chief engineer and general manager of the Foundation Company, Limited, has resigned to join the board of Ruths Steam Storage, Limited.

Mr. William Stewart, formerly assistant secretary of Messrs. Stewarts & Lloyds, Limited, has been appointed secretary of the company, in succession to the late Mr. R. A. Morrison.

Mr. E. C. B. Rowley, chief sales organiser of Messrs. Guest, Keen & Nettlefolds, Limited, Birmingham, has been appointed general manager of Messrs. Harrison (Birmingham), Limited.

The directors of the American Iron & Steel Institute have presented to Mr. Charles M. Schwab a gold folding desk-clock to commemorate his fifty years of constructive service in the iron and steel industry.

Mr. Ernest V. Pannel, technical adviser to the British Aluminium Company, Limited, New York, America, is leaving that country to take up the management of the London Aluminium Company, Limited, of Aston, Birmingham. Mr. Pannel was born and educated in London and has been associated with the British Aluminium Company for the past 20 years.

Obituary.

Mr. Thomas Whiston, foundry manager for the Clay Cross Company, Limited, died recently after nearly 49 years' service with the company. He was 62 years of age.

The death occurred, on October 8, of Mr. David Girdwood, who, before his retirement from business, was secretary to Messrs. Wiliam Beardmore & Company, Limited, Parkhead Forge, Glasgow. Mr. Girdwood, who was in his 75th year, entered the service of the firm in 1876, when the works comprised about 40 puddling furnaces, three rolling mills and a number of steam hammers. During his period of service with the firm Mr. Girdwood was actively associated with the progress of the company, passing through all the departments on the commercial side before being appointed its head. He celebrated the completion of 50 years' service in 1927.

Mr. F. W. Gilbertson, chairman and managing director of Messrs. W. Gilbertson & Company, Limited, steel and tinplate manufacturers, of Pontardawe, died suddenly recently, at the age of 56. He occupied an important position in the Welsh steel and tinplate industry, and was for several years President of the Swansea Metal Exchange and of the South Wales Siemens Steel Association. He was also a director of the Great Western Railway Company, and vice-chairman of the Federation of British Industries. He was the first president of the University College, Swansea, in the founding of which he played a predominant part. During the war he rendered valuable service to the Ministry of Munitions.

Reports and Dividends.

Stothert & Pitt, Limited.—Dividend of 10 per cent., less tax.

Callender's Cable & Construction Company, Limited.—Interim dividend of 5 per cent.

Imperial Chemical Industries, Limited.—Interim dividend of 3 per cent. on the ordinary shares.

Fleming & Ferguson, Limited.—Credit balance, including £10,150 brought in, £29,097; final dividend on the ordinary shares of 2s. per share, making 8 per cent. for the year; to reserve, £7,000; carried forward, £8,297.

Tinsley Rolling Mills Company, Limited.—Credit balance, including £4,917 brought in, £8,759; preference dividend, £2,100; no dividend on the ordinary shares; carried forward, £6,659.

Hurst, Nelson & Company, Limited.—Profit, £74,524; depreciation, £5,636; brought in, £9,629; to reserve, £10,000; final dividend of 2s. per share on the ordinary shares, together with a bonus of 6d. per share, making a total of 4s. per share; carried forward, £10,917.

Neepsend Steel & Tool Corporation, Limited.—Profit, £2,609; brought in, £1,676; transferred from reserve, £30,000; final dividend on the ordinary shares of 6 per cent., making 9 per cent. for the year, and a bonus of 9 per cent.; additional dividend of 4 per cent. on the preference shares, making 10 per cent.; carried forward, £2,720.

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Following the recent rush of autumn buying, the Cleveland iron market has developed a quieter tendency, which may, however, be explained by a substantial decrease in demands by the steelworks, generally the largest consumers of this staple product of the district. The outlook also is hardly as encouraging as might be desired. Home requirements of foundry pig-iron are still fairly substantial, but Cleveland has always relied more or less upon a healthy export trade, which, under present conditions, it is difficult to preserve. In all the principal European markets Cleveland iron is not at a competitive figure. As a matter of fact, shipments of foreign pig-iron are now consigned to Tees-side, where some consumers, even owning their own blast furnaces, are using Continental material. Price reductions would, of course, restore the trade balance, but costs are so high that price-cutting is almost out of the question, and it may be that the alternative of a reduction of output will have to be adopted. So far, however, makers' fixed minima are unchanged, as follow:—No. 1 Cleveland foundry pig-iron, 75s. per ton; No. 3 G.M.B., 72s. 6d.; No. 4 foundry iron, 71s. 6d.; No. 4 forge, 71s. per ton.

In contrast with the situation in the foundry pig-iron section, it is satisfactory to note that demand for East Coast hematite continues active both for home and export. Heavy shipments have been made recently to distant destinations, and one cargo of special iron has gone to the United States. Local producers are now well sold, and quotations for East Coast mixed numbers are now more firmly held at 76s. 6d., and for No. 1 quality at 77s. per ton. On the North-West Coast Bessemer mixed numbers are quoted at 77s. per ton at works.

LANCASHIRE.—The situation in local markets for foundry iron remains fairly satisfactory, requisitions for deliveries against contracts to Lancashire foundries keeping up very well, makers finding it still difficult to keep abreast of them. For Derbyshire and Staffordshire brands, 77s. per ton is quoted for delivery to local consumers, while offers of Scottish iron are fully maintained at up to 93s. 6d. per ton, delivered.

THE MIDLANDS.—With some improvement reported in the local foundry industry, markets for foundry pig, though quiet at the moment, are generally expected to resume buying operations at an early date, and meanwhile prices are firm as follow:—No. 3 Northants, 75s.; No. 3 Derbyshire, 78s. 6d.; No. 3 North Staffordshire, 79s. 6d.; all per ton delivered local stations.

SCOTLAND.—Business in the market for Scotch iron continues very quiet so far as foundry quality is concerned. The Exchange is very poorly attended, and consumers generally do not seem to be much interested in pig-iron. The makers have made no change in the minimum price of 76s. for No. 3 Scotch foundry f.o.t. furnaces.

Finished Iron.

The only outstanding feature in the markets for finished material has been the announcement at Birmingham last week of an advance in the price of marked bars, which has been raised from the £12 level, at which it has existed for months past, to £12 10s. There continues to be quite a good steady demand for this grade of iron as compared with the cheaper qualities, for which inquiry is slow. An average price for crown bars from works in the Staffs is £10, but from outside works iron can be obtained at 5s. per ton less. Nut and bolt iron is offered at £9 to £9 5s., but this is of little interest to consumers, as Belgian No. 3 iron is being offered at as low as £6 10s., and small parcels can be placed at £6 12s. 6d.

Steel.

With the exception of those works engaged in producing shipbuilding material, the orders on the books are being rapidly worked off. The orders from the shipyards, however, continue to keep the steelworks specialising in shipbuilding material fairly busy. At Sheffield, Continental competition in billets is developing again more rapidly than was expected. Siemens acid billet requirements are easily met on a restricted output, and the long period of depression appears to be unending. Basic billets continue to sell very freely, and the demand for wire rods also keeps up well. Prices: Siemens acid billets, £9 10s.; basic billets, soft, £6 17s. 6d.; hard, £7 12s. 6d. to £9 12s. 6d.; soft basic steel hoops, £8 2s. 6d.; wire rods, soft basic, £8 10s.; hard basic, £10 15s.; acid, £12 5s. to £12 10s. The tinplate market continues steady, with quotations firm at 18s. 9d. to 19s., coke quality, net cash, f.o.b. Welsh ports.

Scrap.

Conditions in the principal markets for foundry scrap metal of late have been somewhat irregular in tendency, though on Tees-side there has been no disturbance of the value of ordinary foundry grades of cast iron, which are still quoted at 66s., while machinery quality realises 68s. 6d. In Scotland machinery quality of cast-iron scrap is in better demand, and is quoted at around 70s. to 71s. 6d. Ordinary cast iron to the same specification is at 65s., while cast iron suitable for steelworks has been reduced to 62s. 6d., with few buyers. Old cast-iron railway chairs are unchanged at 68s. to 68s. 6d., and for light cast iron 60s. to 61s. 3d. per ton delivered f.o.t. consumers' works is asked.

Metals.

Copper.—Dealings in the market for warrant copper last week were again restricted in volume, consumers mostly buying for immediate needs in the expectation of obtaining more favourable terms in the near future. Prices, however, remained firm, with little variation, the position, so far, having been unaffected by the reported recent fusion of important interests.

Closing quotations are:—

Cash.—Thursday, £73 11s. 3d. to £73 13s. 9d.; Friday, £73 17s. 6d. to £74s.; Monday, £73 15s. to £73 17s. 6d.; Tuesday, £73 7s. 6d. to £73 10s.; Wednesday, £72 17s. 6d. to £73.

Three Months. — Thursday, £74 2s. 6d. to £74 3s. 9d.; Friday, £74 10s. to £74 12s. 6d.; Monday, £74 2s. 6d. to £74 5s.; Tuesday, £73 12s. 6d. to £73 13s. 9d.; Wednesday, £73 5s. to £73 7s. 6d.

Tin.—The most surprising development of last week's markets for standard tin was the unexpected slump in values below the £200 level, the depression near the close reaching the lowest point since 1923. The position seems hardly to justify such a sudden collapse, except perhaps from the statistical position as regards home stocks, more than 20,000 tons being abnormally large, while American support is withheld pending more favourable buying terms.

Official closing prices:—

Cash.—Thursday, £195 15s. to £196; Friday, £194 10s. to £194 15s.; Monday, £189 15s. to £189 17s. 6d.; Tuesday, £191 2s. 6d. to £191 5s.; Wednesday, £189 15s. to £189 17s. 6d.

Three Months.—Thursday, £200 to £200 2s. 6d.; Friday, £198 10s. to £198 12s. 6d.; Monday, £194 5s. to £194 7s. 6d.; Tuesday, £195 15s. to £195 17s. 6d.; Wednesday, £194 5s. to £194 10s.

Spelter.—Inquiry has shown a slight improvement during the current week, but actual purchases are disappointing. Nevertheless, compared with preceding reports, the tone of the market is certainly steadier, with a slight tendency to firmer values. The consumptive demand is at present low, but it may easily take a turn for the better.

Daily quotations are:—

Ordinary.—Thursday, £23 7s. 6d.; Friday, £23 7s. 6d.; Monday, £23 5s.; Tuesday, £22 15s.; Wednesday, £22 16s. 3d.

Lead.—Very little change is disclosed in the lead market, and the demand from consumers has been quiet of late. The position, however, would appear to be quite sound, and in some quarters an improvement is anticipated in the near future.

The week's prices have been:—

Soft Foreign (Prompt).—Thursday, £23 10s.; Friday, £23 10s.; Monday, £23 10s.; Tuesday, £23 10s.; Wednesday, £23.

Students' Corner.

Q.—Can it be explained why molten metal, when cooling, leaves cavities and porosity in certain sections of the casting?

A.—Apart from evolution of heat, where thick and thin places exist in close proximity in the design of any casting, there is a tendency to porosity and hollow places near those parts. Also, there is a possibility of absorbed gases in the molten metal being released, and then confined in the last remaining parts of the casting to solidify. No reference is now being made to entrapped air, or blow holes, as commonly understood.

Q.—Are there instances where evenly-proportioned sections in a casting have given trouble from liquid shrinkage holes?

A.—There are such which are usually the parts that are most difficult to deal with. These places exist at junctions of metal divided with cores and are practically enclosed with metal, such as small chubby steam chests for turbine engines, cylinder heads for internal-combustion engines, and similar small yet massive castings.

Q.—What happens in these cases to cause this porosity?

A.—When these castings are poured the last places to solidify is about the centre of the casting, the cores dividing the walls of metal at the junctions became as hot as the metal, which fact contributes to keep the metal in a liquid state long after the surrounding walls of metal have set, hence the internal molten area is being drawn from in the natural order of solidification, thus causing a spongy porous place, which is discovered when the water-pressure test is applied.

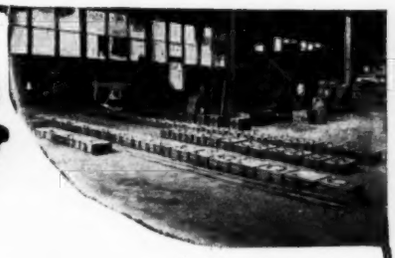
Q.—Should all castings be poured at the same temperature?

A.—Castings of great bulk, if poured with iron that is high in temperature—say, dazzling white, which approximately corresponds to 1,500 deg. C.—such castings would require much more feeding than the same type of casting poured at a lower temperature—say, clear orange—corresponding to a temperature of about 1,300 deg. C.

The correct temperature to pour various castings is found from experience, which involves discernment and judgment, together with a knowledge of the design and function of the castings. For instance, it would serve no useful purpose to pour a hammer block, weighing between 10 and 50 tons, with a metal of dazzling whiteness. On the other hand, it would be unwise to pour such castings as steam or gas cylinders, liners, valves, etc., with an iron of a bright red colour. The temperature of the iron in these two instances to make it suitable for casting requires to be reversed. Intelligently to decide the temperature at which various and special castings are best poured, it is necessary to know the kind of casting, how it is moulded, and how the runner gates are arranged. Certain castings that can with convenience be moulded and poured vertically will, in that position, allow of the metal being considerably lower in temperature than that for the same casting when poured in the horizontal position. On the whole, especially if castings are uniform in design and are not of a very heavy description, a medium temperature—say, bright white, corresponding to 1,400 deg. C.—will produce sound and clean castings, where a temperature of 1,150 deg. C., corresponding to deep orange, would probably fail. Small, intricate, thin castings will always require a fluid iron.

XUM

STERLING



ROLLED STEEL

Moulding Boxes

FOR THE MODERN FOUNDRY

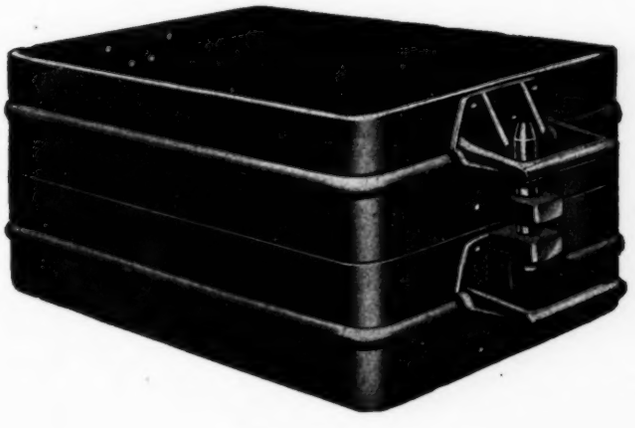
Lightness and ease of handling, robust construction, accuracy and durability are the paramount essentials of the modern moulding box.

These qualities are solidly built into all STERLING ROLLED STEEL MOULDING BOXES.

They are made to suit your exact requirements, drilled to suit your existing pattern plates, and fitted with bars when required to conform to your patterns.

Many of the largest and most up-to-date foundries in this Country and Abroad are completely equipped with STERLING BOXES.

WRITE FOR CATALOGUE No. 37.



STERLING FOUNDRY SPECIALTIES LTD.

London Office :
13, VICTORIA STREET, S.W.1.

BEDFORD

Telephone: 3345 BEDFORD.
Telegrams: "STERFLASK, BEDFORD."
Code: WESTERN UNION.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	72	17	6
Three months	73	5	0
Electrolytic	84	5	0
Tough	77	0	0
Best selected	77	10	0
Sheets	110	0	0
India	94	0	0
Wire bars	84	10	0
Do. Nov.	84	10	0
Do. Dec.	84	10	0
Ingot bars	—		
H.C. wire rods	86	10	0
Off. av. cash, September	75	6	9 11/14
Do. 3 mths., September	75	19	4½
Do., Sttlmnt., September	75	7	1½
Do., Electro, September	84	12	9½
Do., B.S., September	79	18	1½
Do. wire bars, September	84	18	4
Aver. spot price, copper, Sept.	75	6	9 11/14
Solid drawn tubes			15d.
Brazed tubes			15d.
Wire			11½d.

BRASS.

Solid drawn tubes	12½d.
Brazed tubes	14½d.
Rods, drawn	12½d.
Rods, extd. or rlld.	8d.
Sheets to 10 w.g.	11½d.
Wire	11½d.
Rolled metal	10½d.
Yellow metal rods	8d.
Do. 4 × 4 Squares	8½d.
Do. 4 × 3 Sheets	9d.

TIN.

	£	s.	d.
Standard cash	189	15	0
Three months	194	5	0
English	190	5	0
Bars	193	5	0
Straits	195	12	6
Australian	193	12	6
Eastern	197	5	0
Banca	199	2	6
Off. av. cash, September	204	18	9
Do., 3 mths., September	208	17	8½
Do., Sttlmt., September	204	18	5½
Aver. spot, September	204	18	9

SPELTER.

	£	s.	d.
Ordinary	22	16	3
Remelted	21	10	0
Hard	19	10	0
Electro 99.9	24	15	0
English	23	5	0
India	20	10	0
Zinc dust (Nom.)	34	0	0
Zinc ashes	8	0	0
Off. aver., September	24	8	11½
Aver., spot, September	24	4	2

LEAD.

	£	s.	d.
Soft foreign ppt.	23	0	0
English	24	10	0
Off. average, September	23	11	5½
Average spot, September	23	11	1½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	32	0	0
Do. V.M. ex-whf.	31	2	6
Rods	37	0	0
Boiler plates	29	0	0
Battery plates	29	10	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	50	0	0
Chinese	31	0	0
Crude	20	15	0

QUICKSILVER.

	£	s.	d.
Quicksilver	22	7	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
25%	7	15	0
45/50%	11	15	0
75%	19	0	0
Ferro-vanadium—			
35/50%	12/10 lb. Va.		
Ferro-molybdenum—			
70/75% c. free	4/- lb. Mo.		
Ferro-titanium—			
23/25% carbonless	1/2 lb.		
Ferro-phosphorus, 20/25%	£16	0	0
Ferro-tungsten—			
80/85%, c. fr.	3/3½ lb.		
Tungsten metal powder—			
98/99%	3/6½ lb.		
Ferro-chrome—			
2/4% car.	£31	2	6
4/6% car.	£23	5	0
6/8% car.	£21	17	6
8/10% car.	£21	10	0
Ferro-chrome—			
Max. 2% car.	£33	5	0
Max. 1% car.	£38	10	0
Max. 0.70% car.	£40	0	0
70% carbonless	1/- lb.		
Nickel—99% cubes, or pellets	£175	0	0
Ferro-cobalt	9/4 lb.		
Aluminium 98/99%	£95	0	0
Metallic chromium—			
96/98%	2/6 lb.		
Ferro-manganese (net)—			
76/80% loose	£13	10	0
76/80% packed	£14	10	0
76/80%, export	£14	0	0
Metallic manganese—			
94/96%, carbonless	1/6 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 0
Finished bars, 18% tungsten	£0 2 9

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/64 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ½ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Heavy steel				3	15	0
Bundled steel and shrngs.	3	10	0 to	3	14	0
Mixed iron and steel	3	9	0 to	3	10	0
Heavy cast iron	2	17	6 to	2	19	0
Good machinery for foundries	3	2	6 to	3	5	0
Cleveland—						
Heavy steel				3	6	0
Steel turnings				2	15	6
Cast iron borings				2	14	0
Heavy forge				3	17	6
W.I. piling scrap				3	10	0
Cast-iron scrap	3	6	6 to	3	8	6
Lancashire—						
Cast-iron scrap	3	2	6 to	3	10	0
Hvy. wrought				4	0	0
Steel turnings				2	17	6
Scotland—						
Heavy steel				3	15	0
Cast-iron borings				2	15	0
Wrought-iron piling				4	0	0
Heavy machinery				3	11	0

London—Merchants' buying prices delivered yard.

	£	s.	d.	£	s.	d.
Copper (clean)				68	0	0
Brass				44	0	0
Lead (less usual draft)				21	0	0
Tea lead				17	0	0
Zinc				16	0	0
New aluminium cuttings				68	0	0
Braziery copper				59	0	0
Gunmetal				59	0	0
Hollow pewter				150	0	0
Shaped black pewter				106	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	75/-
Foundry No. 3	72/6
Foundry No. 4	71/6
Forge No. 4	71/-
Hematite No. 1	77/-
Hematite M/Nos.	76/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	86/-
,, d/d Birm.	93/6
Midlands—	
Staffs. common*	—
,, No. 4 forge*	75/6
,, No. 3 fdry*	79/6
Shrops. basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	71/-
,, fdry. No. 3*	75/-
Derbyshire forge*	74/6
,, fdry. No. 3*	78/6
,, basic*	—

* d/d Black Country dist.

Scotland—	
Foundry No. 1	78/6
,, No. 3	76/-
Hem. M/Nos.	80/-
Sheffield (d/d district)—	
Derby forge	69/6
,, fdry. No. 3	73/6
Lincs. forge	73/-
,, fdry. No. 3	77/-
E.C. hematite	87/6
W.C. hematite	89/6
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3	77/-
Northants foundry No. 3	—
Dalzell, No 3 (special)	105/- to 107/6
Summerlee, No. 3	93/-
Glengarnock, No. 3	—
Gartsherrie, No. 3	93/-
Monkland, No. 3	93/-
Shotts, No. 3	93/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.) nom.				10	15	0
Nut and bolt iron	9	0	0 to	9	5	0
Hoops	11	0	0 to	11	10	0
Marked bars (Staffs) f.o.t.				12	10	0
Gas strip	11	0	0 to	11	10	0
Bolts and nuts, ¾ in. × 4 in.				15	5	0
Steel—						
Ship plates	8	12	6 to	8	17	6
Boiler plts.	9	12	6 to	10	10	0
Chequer plts.				10	12	6
Angles				8	2	6
Tees				9	2	6
Joists				8	2	6
Rounds and squares, 3 in. to 5½ in.				9	2	6
Rounds under 3 in. to ¾ in. (Untested)				8	5	0
				and upwards		
Flats, over 5 in. wide and up				8	2	6
Rails, heavy				8	10	0
Fishplates				12	10	0
Hoops (Staffs)				9	15	0
Black sheets, 24g.				10	7	6
Galv.cor.shts., 24g.	13	5	0 to	13	10	0
Galv. fencing wire 8g. plain				12	0	0
Billets, soft	6	5	0 to	6	15	0
Billets, hard	7	10	0 to	8	0	0
Sheet bars				6	5	0
Tin bars				6	5	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1/4
Sheet to 10 w.g.	1/5
Wire	1/6½
Rods	1/5
Tubes	1/9½
Castings	1/4

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	10d. to 1/4
Rolled—	
To 9 in. wide	1/4 to 1/10
To 12 in. wide	1/4½ to 1/10½
To 15 in. wide	1/4½ to 1/10½
To 18 in. wide	1/5 to 1/11
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6 to 2/-
Ingots for spoons and forks	10d. to 1/6½
Ingots rolled to spoon size	1/1 to 1/9½
Wire round—	
3/0 to 10 G.	1/7½ to 2/2½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	21.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.50
Basic	20.26
Bessemer	20.76
Malleable	20.76
Grey forge	19.76
Ferro-mang. 80% d/d	105.00
O.-h. rails, h'y at mill	43.00
Bessemer billets	35.00
O.-h. billets	35.00
O.-h. sheet bars	35.00
Wire rods	40.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.90
Tank plates	1.95
Beams, etc.	1.90
Skelp, grooved steel	1.90
Skelp, sheared steel	1.90
Steel hoops	2.20
Sheets, black, No. 24	2.85
Sheets, galv., No. 24	3.50
Sheets, blue an'l'd, No. 13	2.35
Wire nails	2.45
Plain wire	2.40
Barbed wire, galv.	3.10
Tinplates, 100 lb. box	$5.35

COKE (at ovens).

Welsh foundry	27/6
,, furnace	22/6 to 24/-
Durham and North.	
,, foundry	22/6
,, furnace	21/-
Midlands, foundry	—
,, furnace	21/6 and up

TINPLATES,

f.o.b. Bristol Channel ports.

I.C. Cokes	20×14 box	18/9
,,	28×20 ,,	37/6
,,	20×10 ,,	27/6
,,	18¾×14 ,,	19/6
C.W.	20×14 ,,	15/6
,,	28×20 ,,	34/-
,,	20×10 ,,	22/7½
,,	18¾×14 ,,	16/-
Terneplates	28×20	33/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0 to	£7	10	0
Bars, hammered, basis	£17	10	0 to	£18	10	0
Bars and nail-rods, rolled, basis	£15	15	0 to	£16	15	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£32	0	0 to	£33	0	0
Faggot steel	£20	0	0 to	£24	0	0
Bars and rods dead soft, steel	£11	0	0 to	£14	0	0

All per English ton, f.o.b. Gothenburg.

XUM

TUBES AND FITTINGS.

Over ½ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	65%	47½%
Water	61½%	42½%
Steam	57½%	37½%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Oct. 10		73	1!	3	dec.	17/6
„ 11		73	17	6	inc.	6/3
„ 14		73	15	0	dec.	2/6
„ 15		73	7	6	„	7/6
„ 16		72	17	6	„	10/–

Electrolytic Copper.

		£	s.	d.		
Oct. 10		84	5	0	No	change
„ 11		84	5	0	„	„
„ 14		84	5	0	„	„
„ 15		84	5	0	„	„
„ 16		84	5	0	„	„

Standard Tin (cash).

		£	s.	d.		
Oct. 10		195	15	0	dec.	15/–
„ 11		194	10	0	„	25/–
„ 14		189	15	0	„	95/–
„ 15		191	2	6	inc.	27/6
„ 16		189	15	0	dec.	27/6

Tin (English ingots).

		£	s.	d.		
Oct. 10		196	0	0	dec.	15/–
„ 11		194	10	0	„	30/–
„ 14		189	15	0	„	95/–
„ 15		191	5	0	inc.	30/–
„ 16		190	5	0	dec.	20 –

Zinc Sheets (English).

		£	s.	d.		
Oct. 10		32	5	0	dec.	10/–
„ 11		32	5	0	No	change
„ 14		32	5	0	„	„
„ 15		32	0	0	dec.	5/–
„ 16		32	0	0	No	change

Spelter (ordinary).

		£	s.	d.		
Oct. 10		23	7	6	dec.	5/-
„ 11		23	7	6	No	change
„ 14		23	5	0	dec.	2/6
„ 15		22	15	0	„	10/–
„ 16		22	16	3	inc.	1/3

Lead (English).

		£	s.	d.		
Oct. 10		24	15	0	No	change
„ 11		24	15	0	„	„
„ 14		24	15	0	„	„
„ 15		24	15	0	„	„
„ 16		24	10	0	dec.	5/–

Exports of Iron Castings in September and the nine months 1929, compared with September and the nine months 1928.

	Sept., 1928.	Sept., 1929.	Nine months, 1928.	Nine months, 1929.	Sept., 1928.	Sept., 1929.	Nine months, 1928.	Nine months, 1929.
	Tons.	Tons.	Tons.	Tons.	£	£	£	£
BUILDERS' CASTINGS—								
Stoves, Grates, etc., Cisterns, Baths, etc., and cooking and washing boilers—								
To Argentine Republic	104	149	1,327	1,514	3,753	6,839	55,123	70,043
„ British South Africa	202	186	2,641	2,571	7,590	7,237	92,657	92,627
„ „ India	71	84	1,099	1,216	3,100	3,471	47,954	47,342
„ Australia	30	51	489	542	1,976	2,882	33,827	30,785
„ New Zealand	91	112	1,377	1,043	5,763	6,722	70,690	64,721
„ Other countries	638	754	6,985	7,471	31,519	36,033	325,338	343,241
Total	1,136	1,336	13,918	14,357	53,701	63,184	625,589	648,759
PIPES AND FITTINGS—CAST—								
To Argentine Republic	575	1,597	6,909	19,792	6,879	13,585	71,194	184,533
„ British South Africa	374	149	3,514	4,754	4,564	2,563	54,397	63,717
„ „ India	342	176	6,372	3,373	4,810	3,083	84,772	46,159
„ Straits Settlements and Malay States	793	1,727	11,428	17,249	8,688	12,863	106,049	125,890
„ Ceylon	34	154	1,631	1,663	422	1,225	16,621	16,653
„ Australia	876	118	7,337	2,969	7,910	2,477	80,070	33,683
„ Other countries	3,699	8,178	42,683	49,601	44,636	89,380	557,093	595,799
Total	6,693	12,099	79,874	99,401	77,909	125,176	970,196	1,066,434
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	255	364	3,343	3,542	12,710	12,578	126,557	126,645
„ Enamelled	45	73	566	694	5,213	6,694	54,432	62,312
CASTINGS, in the rough—								
Iron	174	124	1,206	1,152	4,532	4,592	37,357	41,991
Steel	43	100	455	957	1,630	3,808	21,064	39,191

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-.

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

PATTERNMAKER (Working Foreman), age 36, at present in the North, desires change, anywhere; good all-round experience, machine and all classes of moulding.—Box 354, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

PRACTICAL FOUNDRYMAN desires re-engagement as Foreman, iron or non-ferrous.—Box 350, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

WANTED, Charge-hand Foreman for Steel Foundry near London district; must be used to small castings; good prospects.—State experience, wages, etc., to Box 344, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY MANAGER wanted, first-class man, to take charge of Iron Foundry in the Midlands; small repetition work—grey iron; must have thorough practical and technical knowledge, also first-class experience of machine-moulding methods; good position for right man; state age, experience, salary required.—Apply in confidence, Box 352, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

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